Naval Research Laboratory
Stennis Space Center, MS 39529-5004

NRL/MR/7180--04-8724

Distribution of Fishing Boats Off Nova Scotia

RICHARD H. LOVE

Bayou Acoustics
Pass Christian, MS

LISA A. PFLUG

Acoustic Simulation, Measurements, and Tactics Branch
Acoustics Division

October 29, 2004

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. REPORT DATE *(DD-MM-YYYY)*	2. REPORT TYPE	3. DATES COVERED *(From - To)*
29-10-2004	Memorandum	

4. TITLE AND SUBTITLE

Distribution of Fishing Boats Off Nova Scotia

5a. CONTRACT NUMBER

5b. GRANT NUMBER

5c. PROGRAM ELEMENT NUMBER
63207N

6. AUTHOR(S)

Richard H. Love* and Lisa A. Pflug

5d. PROJECT NUMBER
71-7076-A3

5e. TASK NUMBER

5f. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

Naval Research Laboratory
Acoustic Simulation, Measurements, and Tactics Branch
Stennis Space Center, MS 39529-5004

8. PERFORMING ORGANIZATION REPORT NUMBER

NRL/MR/7180--03-8724

9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)

Mr. Kim Koehler, Assistant APM, USW
Space and Naval Warfare Systems Command
Meteorology and Oceanography Systems, PMW 155-12A
4301 Pacific Highway, Building OT-1
San Diego, CA 92110-3127

10. SPONSOR / MONITOR'S ACRONYM(S)

SPAWAR

11. SPONSOR / MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION / AVAILABILITY STATEMENT

Approved for public release; distribution is unlimited.

13. SUPPLEMENTARY NOTES

*Bayou Acoustics, Pass Christian, MS 39571

14. ABSTRACT

The Historical Interim Temporal Shipping (HITS) database contains ship densities on a seasonal or monthly basis for five classes of vessels: super tanker, large tanker, tanker, merchant, and fishing. A new version of the database was recently created and included new fishing vessel densities for selected areas derived from recent United Nations Food and Agriculture Organization (FAO) reports. As part of a noise model validation effort, more detail about the fishing vessels in the area off Nova Scotia was required, and this report presents the results of that study as well as documents the process required to derive fishing boat densities. The study determined how many boats of different sizes are fishing in a given location off Nova Scotia in different seasons. The study largely consisted of obtaining, analyzing, distilling, and quantifying information on individual species and the boats that catch them. Nearly all the information used to determine the seasonal distribution of fishing boats off Nova Scotia was obtained from the Canadian Department of Fisheries and Oceans (DFO). The study found nearly 5000 boats fishing in the region, with nearly 94% less than 45 ft long, and provides the geographic distribution of fishing vessels for 15 species of fish.

15. SUBJECT TERMS

Fishing; Fishing vessels; Fishing boats; Nova Scotia; Shipping densities

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			Lisa A. Pflug
Unclassified	Unclassified	Unclassified	UL	47	19b. TELEPHONE NUMBER *(include area code)* 228-688-5574

Standard Form 298 (Rev. 8-98)
Prescribed by ANSI Std. Z39.18

CONTENTS

DISTRIBUTION OF FISHING BOATS OFF NOVA SCOTIA

INTRODUCTION

The Historical Interim Temporal Shipping (HITS) database contains ship densities on a seasonal or monthly basis for five classes of vessels, and is the main source of data for predicting ambient shipping noise in the ocean. Coverage is nearly global, and the five vessel types are super tanker, large tanker, tanker, merchant, and fishing. The database was recently upgraded by Planning Systems Incorporated under sponsorship of PEO (C41 and Space), PMW 155 (MetOC Systems) and submitted for inclusion in the Oceanographic Master Library (OAML) (Emery et al., 2001). The most current version of HITS (Version 4.0) coordinates with the newly developed Historical Vessel Motion Simulator (HVMS, Version 1.0) (Bradley et al., 2001), which moves non-fishing vessels along defined lanes in and out of a selection of worldwide ports, and fishing vessels in a random walk. The fishing vessel densities in the database were upgraded using recent data from the United Nations Food and Agriculture Organization (FAO) for selected areas. As part of a noise model validation effort, more detail about the fishing vessels in the area off Nova Scotia was required, and this report presents the results of that study. To improve the fishing vessel component of HITS and HVMS, a similar analysis would have to be conducted for all significant fishing areas.

The object of this study was to determine how many boats of different sizes are fishing in a given location off Nova Scotia in different seasons. The study largely consisted of obtaining, analyzing, distilling, and quantifying information on individual species and the boats that catch them. Information on the numbers, types, and sizes of all Canadian fishing boats can be found in the "Bulletin of Fishery Statistics: Fishery Fleet Statistics 1970, 1975, 1980, 1985, 1989-1995" published in 1998 by the FAO. However, almost all the information used to determine the seasonal distribution of fishing boats off Nova Scotia was obtained from the Canadian Department of Fisheries and Oceans (DFO) web page (www.dfo-mpo.gc.ca). Both statistics and reports were downloaded from the web page. Available statistics included numbers of fishing boats by province and length; fishing licenses by province and species group (usually more licenses than boats); and catch by species and province. The reports included species status reports, research reports, and fishery management plans.

The statistical data obtained from DFO do not require interpretation. Hence, pertinent general data on boats and species can be presented directly without further analysis.

Table 1 shows the latest (1999) statistics for boats fishing around Nova Scotia, including the Bay of Fundy. There are almost 5000 boats fishing in the region, most of which are relatively small; 94% are less than 45' long.

Table 2 shows the latest (2001) catch statistics for important species of groundfish, pelagic fish, and shellfish for the waters around Nova Scotia, including the Bay of Fundy. The species included in Table 2 are those which are considered in the development of the fishing boat distributions. "Other" species account for almost 12% of the groundfish but only 3% of all species. Catches of individual "other" species were deemed to be too small to be considered. There are two numbers in the table that are uncertain. Catches of sharks were not available for 2001, so an estimate was made based on previous years. The catch of scallops listed in the table is much higher than weights given in scallop species reports. The species reports consider scallop "meats"; it is possible that the weights in Table 2 include scallop shells.

Manuscript submitted October 13, 2003.

Table 1. DFO fishing boat sizes and numbers for 1999.

BOAT LENGTH	PROVINCE		
	NOVA SCOTIA	NEW BRUNSWICK	TOTAL
< 35'	2214	251	2465
35'-40'	842	138	980
40'-45'	898	159	1057
45'-50'	14	13	27
50'-55'	16	4	20
55'-60'	37	7	44
60'-65'	79	22	101
65'-100'	25	11	36
> 100'	54	3	57
TOTAL	4179	608	4787

Table 2. DFO fish catch weights for Nova Scotia in 2001 (metric tons).

SPECIES	PROVINCE		
	NOVA SCOTIA	NEW BRUNSWICK	TOTAL
GROUNDFISH			
Cod	9188	260	9448
Haddock	15364	28	15392
Redfish	10785	0	10785
Flatfish	5679	18	5697
Pollock	6216	93	6309
Hake	21440	29	21469
Other	8820	230	9050
Sub-total	77492	658	78150
PELAGIC FISH			
Herring	75197	39066	114263
Mackerel	3096	170	3266
Swordfish	899	0	899
Tuna	663	0	663
Shark	1200	0	1200
Other	677	1	678
Sub-total	81732	39237	120969
SHELLFISH			
Clams	7999	46	8045
Scallops	84064	1642	85706
Lobster	25087	2455	27542
Shrimp	29663	2	29665
Crabs	13161	500	13661
Sea Urchins	454	1460	1914
Other	733	656	1389
Sub-total	161161	6761	167922
TOTAL	320385	46656	367041

The species status reports, research reports, and management plans may give: (a) geographic distribution of species, (b) fishing season, (c) catch by season or month, (d) catch by location, (e) number of boats and/or licenses by location; (f) sizes and types of boats; (g) level of effort in number of trips or days fished, and (h) other indirectly useful information. For some species there is enough information in the reports to determine directly the seasonal distribution of fishing boats. However, for most species some information was lacking that had to be deduced, interpolated, extrapolated, etc., before boats could be distributed. In some cases, conflicting information had to be resolved. Much of the information is given based on North Atlantic Fishery Organization (NAFO) Fishing Areas. Figure 1 shows the NAFO areas around Nova Scotia.

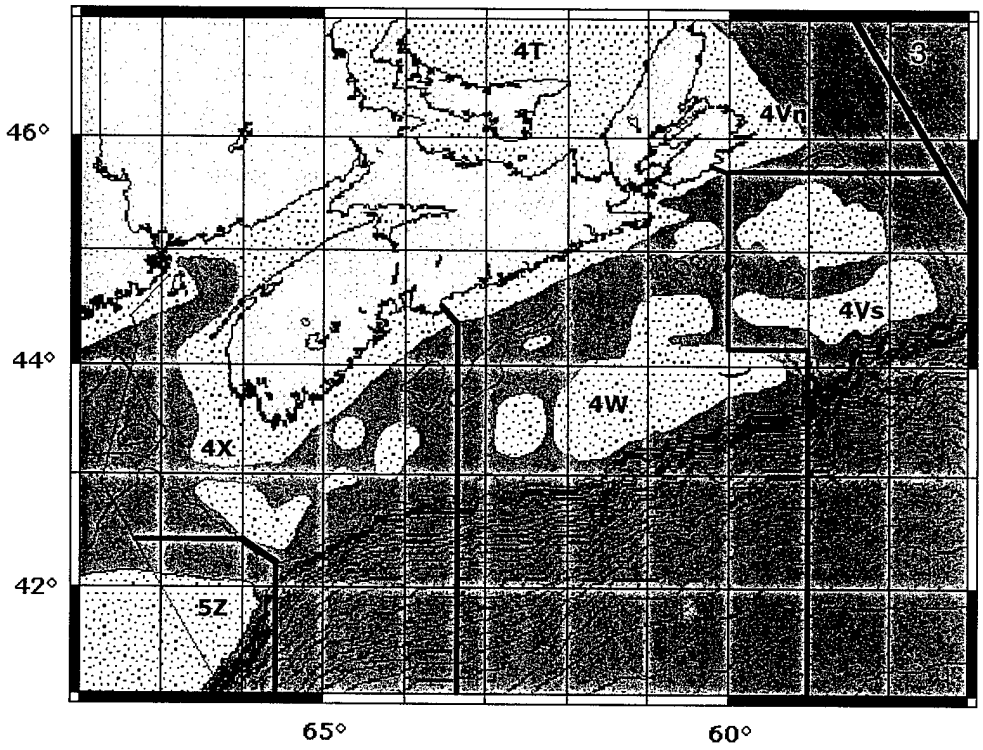

Fig. 1 — NAFO fishing areas surrounding Nova Scotia

The available Species Status Reports, Research Reports, and Management Plans for each species of interest were read and notes were taken. Status reports generally included figures showing either the geographic distribution of a species or the geographic distribution of fishing effort. The notes are included as Appendices A, B, and C, for groundfish, pelagic fish, and shellfish, respectively. The appendices also include a listing of all the source material.

DFO SPECIES SUMMARIES

The information in the appendices for each species or group of closely related species was distilled to produce numbers, sizes and types of boats; geographic area; fishing season, including monthly or seasonal effort; catch by area; and other information, such as number of days fished. As stated above, not all required information was available for each species. In particular, boat numbers for groundfish are based on catches of different species by different boats and gear. This procedure is explained in Appendix A. Other than the groundfish boat numbers, most of the other information given below was determined from the DFO documents.

Along with the summaries for each species, figures developed from the species status reports are presented showing the geographic distribution of each species or species group. Also included in these figures are numbers of boats of different sizes fishing in different geographical areas at any time during the year. For many species, boats were distributed assuming that it takes the same fishing effort to catch a species anywhere within its range, or that the catch per unit effort (CPUE) is the same for all locations. Thus, if N boats catch a tons of a species in area A and b tons in area B, then $[Na/(a + b)]$ boats fish in area A and $[Nb/(a + b)]$ boats fish in area B.

An examination of the information presented below shows that DFO statistics use slightly different size ranges for trawlers and fixed gear boats. It was decided that there were few fixed gear boats smaller than 30' and that there were few trawlers smaller than 45'. Also, unless otherwise noted, boats listed as > 100' were normally < 150'. Thus, for this study, the DFO size ranges have been modified to produce a single set of rather odd size ranges: 30'-40', 40'-45', 45'-65', 65'-100', 100'-150' and > 150'. In the figures, different size ranges are designated by different type styles: 30'-40' is (plain text with parentheses), 40'-45' is plain text, 45'-65' is *italicized text*, 65'-100' is plain text underlined, and > 100' is *italicized text underlined*.

GROUNDFISH

Cod (Figure 2)

Boats/Gear:	8	< 65'	Trawlers (SSS/BOF)
	2	< 65'	Trawlers (Georges)
	249	< 40'	Gillnet/Longline (SSS/BOF)
	49	40'-45'	Gillnet/Longline (Georges)
	9	45'-65'	Gillnet/Longline (Georges)
	5	65'-100'	Gillnet/Longline (Georges)
Area:	Southern Scotian Shelf (SSS), Bay of Fundy (BOF) and Georges Bank. Areas 4V and 4W are closed. There is also a "haddock box" in Area 4W that is closed to all groundfishing.		
Season:	Year round. Browns Bank is closed February through mid-June. Georges Bank is closed January through early June.		
Catch:	6000 tons in SW Nova Scotia and Bay of Fundy. 1600 tons on Georges Bank.		

Haddock (Figure 2)

Boats/Gear:	16	< 65'	Trawlers (SSS/BOF)
	12	< 65'	Trawlers (Georges)
	243	< 40'	Gillnet/Longline (SSS/BOF)
	43	40'-45'	Longline (Georges)
	7	45'-65'	Longline (Georges)
	4	65'-100'	Longline (Georges)
Area:	Southern Scotian Shelf, Bay of Fundy and Georges Bank. Primarily 50-250 m. Areas 4V and 4W are closed. There is also a "haddock box" in Area 4W that is closed to all groundfishing.		
Season:	Year round. Browns Bank is closed February through mid-June. Georges Bank is closed January through early June.		
Catch:	7800 tons in SW Nova Scotia and Bay of Fundy; 5200 tons by trawlers and 2600 tons with gillnets and longlines. 5400 tons on Georges Bank.		
Other:	Boats made 620 10 day trips to Georges Bank.		

Pollock (Figure 3)

Boats/Gear:	1	> 100'	Trawlers (Area 5)
	2	65'-100'	Trawlers (Area 5)

	1	< 65'	Trawlers (Area 4W)
	6	< 65'	Trawlers (Areas 4X)
	129	< 45'	Gillnet/Longline (Area 4W)
	122	< 40'	Gillnet/Longline (SSS/BOF)
	21	40'-45'	Gillnet/Longline (Georges)
	4	45'-65'	Gillnet/Longline (Georges)
	2	65'-100'	Gillnet/Longline (Georges)

Area: Scotian Shelf, Bay of Fundy and Georges Bank. There is a "haddock box" in Area 4W that is closed to all groundfishing.

Season: Year round. Browns Bank is closed February through mid-June. Georges Bank is closed January through early June.

Catch: 5500 tons; 3000 tons in Area 4X, 2000 tons in Area 5, and 500 tons in Area 4W. Trawlers < 65' caught 42%, large trawlers caught 16%, and fixed gear caught 41%.

Silver Hake (Figure 4)

Boats/Gear:	37	< 65'	Trawlers
	5	> 100'	Trawlers

Area: Emerald and LaHave Basins and shelf edge west of 60°W. Depths > 200 m.

Season: Year round.

Catch: 12900 tons in 2000. 85% in basins, 15% shelf edge.

Other: Smaller boats fishing basins, larger boats shelf edge.

Redfish (Figure 5)

Boats/Gear:	16	45'-65'	Trawlers	(Area 4W and 4X)
	12	45'-65'	Trawlers	(Area 4V)
	2	> 100'	Trawlers	(Area 4W and 4X)
	3	> 100'	Trawlers	(Area 4V)

Area: 100-700 m on slopes of banks, channels, basins, and the shelf edge.

Season: Year round. 55-60% caught in May-July; 25% in August-October; 5-10% in November-March. North of 43°30'N is closed year round, as is < 50 fm.

Catch: 4000-5000 tons in Area 4V.
5000-6000 tons in Areas 4W and 4X; 70-75% from Crowell and Jordan Banks, 10-15% from Emerald and LaHave Basins, 5% from Roseway Basin, and 10-15% from the slope.

Other: Smaller trawlers catch almost all the fish. In Areas 4W and 4X, small boats made 300 5 day trips and larger boats fished 20-50 days each.

Flatfish (Figure 6)

Boats/Gear:	21	<65'	Trawlers

Area: Primarily Sydney Bight and Banquereau Bank in Areas 4V and 4W. South and west of SW Nova Scotia and Bay of Fundy in Area 4X. Georges Bank in Area 5.

Season: Year round. (Georges Bank open early June through December.)

Catch: 1700-2000 tons in Areas 4V and 4W. 1700-2200 tons in Area 4X. 2000-2900 tons on Georges Bank.

PELAGIC FISH

Herring (Figure 7)

Purse Seine

Boats/Gear:	28	40'-45'	Purse seine
Area:	Upper and lower Bay of Fundy, off SW Nova Scotia, around Browns Bank, near Emerald Basin, near Halifax.		
Season:	Year round. In 2000, 1% of catch in January, 3% in May, 8% in June, 22% in July, 26% in August, 23% in September, 15% in October, and 2% in November.		
Catch:	83760 tons in 2000. From 1996-2000, 40-50% from SW Nova Scotia (13 boats); 15-40% from lower Bay of Fundy (7 boats), 2-13% from upper Bay of Fundy (3 boats), 2-30% from near Emerald Basin (4 boats), 1-5% from around Browns Bank (1 boat), and 1% from near Halifax.		

Gillnets

Boats/Gear:	2050	< 40'	Gillnets
Area:	Small coastal areas off SW Nova Scotia, near Liverpool and Halifax, Glace Bay, Bras D'Or.		
Season:	June through November but almost all the catch is in September and October. 1900-0700 Sunday through Thursday. Boats fish 20-30 nights.		
Catch:	5100 tons in 2000. 16% from SW Nova Scotia (330 boats), 40% from Liverpool (820 boats), 26% from Halifax (540 boats), and 18% from Cape Breton I. (360 boats).		

Weirs and Traps

Boats/Gear:	270	< 40'	Weirs and Traps
Area:	Mouth of the Bay of Fundy		
Season:	July through November. In 2000, 13% of catch was in July, 45% in August, 30% in September, 10% in October, and 1% in November.		
Catch:	About 24000 tons in 1997-1999. 80% from New Brunswick (215 boats), 20% from Nova Scotia (55 boats).		

Mackerel (Figure 8)

Boats/Gear:	202	< 40'	Trap
	1840	< 40'	Gillnet
	725	< 45'	Handline/Jigger
	44	< 45'	Purse seine
Area:	Close inshore		
Season:	Along the Nova Scotia coast, 81% of the catch was in June, 11% in May, an 2%/month from July through October.		
Catch:	About 4000 tons along the Nova Scotia coast and Bay of Fundy between 1995 and 1999. 11% near Canso (22 Trap and 66 Gillnet); 3% east of Halifax (6 Trap and 18 Gillnet); 81% west of Halifax (164 Trap and 486 Gillnet); 3% off Shelburne (6 Trap and 18 Gillnet); and 2% on the New Brunswick side of the Bay of Fundy (4 Trap and 12 Gillnet).		
Other:	Purse seiners, handline/jggers and 2/3 of the gillnetters licensed in Scotia-Fundy are fishing in the Gulf of St Lawrence. Gillnetters catch herring during herring season.		

Tuna (Figure 9)

Boats/Gear:	1	65'-100'	Longline
Area:		Albacore and bigeye are caught along the edge of the Scotian Shelf. Yellowfin are caught on Georges Bank and the banks on the Scotian Shelf.	
Season:		Year round. But tuna migrate and are in the region during the summer.	
Catch:		600-700 tons from 1996-2000. About half bigeye/albacore and half yellowfin.	
Other:		The 67 swordfish boats can also fish for tuna and must follow swordfish regulations as to season and closed areas.	

Swordfish (Figure 9)

Boats/Gear:	60	< 65'	Longline
	7	65'-100'	Longline
Area:		Edges of Georges Bank and Scotian Shelf	
Season:		June through December east of 65°30'W and August through December west of 65°30'W. (Season mostly ends in October in both areas.) There is an area off the coast of Nova Scotia that is closed from September-December, but it doesn't actually affect swordfishing.	
Catch:		600-1000 tons from 1996-2000.	

Sharks (Figure 10)

Boats/Gear:	3	> 100'	Longline/Offshore Freezer
	20	65'-100'	Longline/"Inshore"
Area:		Porbeagles and blues move onto the Scotian Shelf in late spring and back to deeper water in late fall.	
Season:		Year round. Primary season for porbeagles off Nova Scotia is spring. For blues it is fall and early winter. Catches for both are primarily off the shelf.	
Catch:		1000-2000 tons from 1992-1996. 80% porbeagle, the rest mostly blue and mako. 90% by offshore/freezer boats.	

SHELLFISH

Lobster (Figure 11)

Eastern Shore of Nova Scotia

Boats/Gear:	300	Average Length = 32'	Trap
Area:	45-50 days from April to June. Uniform catch.		
Catch:	400-450 tons in 1995-1997		

Southern Shore of Nova Scotia

Boats/Gear:	760	Avg L = 36'	Trap
Area:	Inside 30 fm (50 m)		
Season:	50 days from December to May. 50% catch in 1st half of December.		
Catch:	1450-1800 tons in 1995-1997		

Southwest Nova Scotia (Inshore/Midshore Fleet)

Boats/Gear:	980	< 40'	Trap
Area:	Inshore:	Inside 30 fm (50 m)	
	Midshore:	Out to 50 nm	
Season:	December to May. 50% of catch in December, 20% in May.		
Catch:	10000-13000 tons in 1995-2000		
Other:	100 to 200 of the 980 boats fish midshore all or part of the season. 90% of catch inshore.		
	Browns Bank is closed.		

Southwest Nova Scotia (Offshore Fleet)

Boats/Gear:	8	2: 56-65', 6: 100'-140'	Trap
Area:	50 nm from shore off SE and west Browns Bank (Crowell Basin, Georges Basin, NE Channel) and Georges Bank. Browns Bank is closed.		
Season:	Year round. Highest catch in November-December.		
Catch:	700 tons		
Other:	4-5 day trips.		

Bay of Fundy

Boats/Gear:	340	< 40'	Trap
Area:	Inside 30 fm (50 m)		
Season:	15 October through July.		
Catch:	1500-2600 tons in 1995-2000		

Eastern Cape Breton

Boats/Gear:	656	< 40'	Trap
Area:	Inside 30 fm (50 m)		
Season:	15 May to 15 June.		
Catch:	1500 tons in 1997.		

Scallops (Figure 12)

Offshore

Boats/Gear:	28	90-150'	Drags/Rakes
Area:	South of 43°40'N on Banquereau, Sable, Western, Browns, German and Georges Banks. Depths of 35-120 m.		
Season:	Year round except June to 15 November on German Bank. Effort on Georges Bank from April through September about twice that from October through March.		
Catch:	5200 tons in 1997. In 1998 & 1999, 74% of the effort was on Georges Bank (21 boats), 11% on Browns (3 boats), 8% on German (2 boats), and 7% on the eastern banks (2 boats).		
Other:	509 trips (18 trips/boat)		

Bay of Fundy

Boats/Gear:	99	45'-65'	Drags/Rakes
	226	< 45'	Drags/Rakes
Area:	North of 44°18'N. Depths of 35-120 m.		
Season:	Year round. (Different in different parts of Bay.)		
Catch:	650 tons in 2001, 400 tons by 45'-65' boats, 250 tons by < 45' boats.		
Other:	The 99 45'-65' boats fished about 300 hours or 20 days each		

Outside Bay of Fundy

Boats/Gear:	99	45'-65'	Drags/Rakes
	Same boats that fish Bay of Fundy		
Area:	Within 12 nm of the coast around to 65°30'W. Depths of 35-120 m.		
Season:	June to October south of 44°18'°N and north of 43°40'N. June 11 through August south of 43°40'N.		
Catch:	160 tons north and 400 tons south of 43°40'N in 2001.		
Other:	The 99 boats fished about 400 hours or about 30 days each		

Shrimp (Figure 13)

Eastern Nova Scotia (Offshore)

Boats/Gear:	23	<65'	Trawl
	6	65'-100'	Trawl
Area:	Deep holes SE of Canso and east of Cape Breton I.		

Season: Year round. But larger boats start mid March and catch their 25% quota by end of June.
Smaller boats start mid April and catch 75% of their 75% quota by end of July and continue through October.

Catch: About 5000 tons in 1999 and 2000. 85-90% from SE of Canso. 10-15% from east of Cape Breton I. Thus, 20 and 5 boats SE of Canso; 3 and 1 east of Cape Breton I.

Other: Fished 941 days, 3-4 day trips = 270 trips.

Eastern Nova Scotia (Inshore)

Boats/Gear: 14 Trawl/Trap

Area: Inshore along southern Cape Breton I.

Season:

Catch: 150 and 120 tons in 1999 and 2000.

Far North

Boats/Gear: 13 Factory Freezer Trawlers

Area: North of 49°15'N

Season: Year round.

Catch: 24000 tons

Other: Boats make 25-75 day trips.
Larger boats make 6-8 trips; out 270-320 days.
Smaller boats make 8-10 trips; out 200-250 days.
Landings in Nova Scotia and Newfoundland.

Crabs (Figure 14)

Red Crab

Boats/Gear: 5 "Large" Trap

Area: Between 380-760 m from US/Canada border to east end of Emerald Bank.

Season: Effort is 5% in winter, 30% in spring and fall, and 35% in summer.

Catch: 700 tons in 1995 & 1996. 30-50% off Emerald Bank (2 boats), 30% off Georges Bank (2 boats), 20-40% off Browns and LaHave Banks (1 boat).

Rock Crab

Bay of Fundy

Boats/Gear: 10 < 40' Trap

Area: < 20 m

Season: 70% summer, 30% fall

Catch: 60 tons in 1998/1999.

Other: 6 boats in New Brunswick, 4 in Nova Scotia.

Eastern Nova Scotia

Boats/Gear: 10 < 40' Trap

Area: < 20 m

Season: July through December, evenly distributed.

Catch: 50 tons in 1998/1999.

Other: Fish 35-40 days/year.

Eastern Cape Breton I.

Boats/Gear: 17 < 40' Trap

Area: < 20 m

Season: July through December, evenly distributed.

Catch: 200 tons in 1998/1999.

Other: Fish 75 days/year.

Snow (Queen) Crab

Southwestern Nova Scotia

Boats/Gear: 4 Trap

Area: 90-180 m. Roseway Basin and north of LaHave Basin.
Season: November through May.
Catch: 200 tons in 2000/2001.
Other: Fish 60 days per year.

Northeastern Cape Breton I.
Boats/Gear: 80 Trap
Area: 50-280 m.
Season:
Catch: 1100 tons in 2000/2001.

Southeastern Cape Breton I.
Boats/Gear: 85 Trap
Area: 50-280 m.
Season: June-?
Catch: 4400/4800 tons in 2000/2001.

Eastern Nova Scotia
Boats/Gear: 82 Trap
Area: 50-280 m.
Season: June-?
Catch: 4300/4000 tons in 2000/2001.

Jonah Crab

Bay of Fundy
Boats/Gear: 5 Trap
Area: 50-300 m. Near Grand Manan I.
Season: June through October
Catch: 60/50 tons in 1998/1999.

Southwestern Nova Scotia
Boats/Gear: 5 Trap
Area: 50-300 m. The "midshore" near Jordan Basin.
Season: June through October
Catch: 50/120 tons in 1998/1999.

Western Scotian Shelf
Boats/Gear: 10 Trap
Area: 50-300 m. 12-50 nm offshore along northern and western LaHave Basin.
Season: June 15 to November 15
Catch: 160 tons in 1998/1999.
Other: Fish 15-20 days/year. About 60 trips of 3-4 days.

Offshore
Boats/Gear: 8 Trap
Area: Georges Bank, around Browns Bank, and Georges and Crowell Basins.
Season: Year round, starting in October. Browns Bank closed.
Catch: 700 tons from 1996-1999.

Clams (Figure 15)

Offshore
Boats/Gear: 3 200' Dredge/Freezer
Area: Banquereau and Grand Banks
Season: Year round.
Catch: In 1995 and 1996, 25000 tons; 10000 and 19000 were from Banquereau.
Other: 42 day trips.

Inshore
Boats/Gear: 33 < 40' Dredge
Area: SW Nova Scotia, inside 12 nm.
Season:

Catch:

Quahaugs

Boats/Gear: 3 < 40' Dredge
Area: SW Nova Scotia, inside 12 nm.
Season:
Catch: 140 tons in 1996.
Other: Day trips. Fished by inshore clam fisherman.

Sea Urchins (Figure 16)

New Brunswick

Boats/Gear: 31 Can carry 2 skiffs Divers
Area: < 10 m. Around Grand Manan I. and adjacent coast.
Season: October through April.
Catch: 1400-1900 tons from 1995-2000.

Nova Scotia

Boats/Gear: 31 Can carry 2 skiffs Divers
5 on Cape Breton I. 13 in eastern mainland. 7 in Shelburne County. 6 in Digby County.
Area: < 10 m.
Season: September through March.
Catch: 900-1300 tons from 1995-2000.

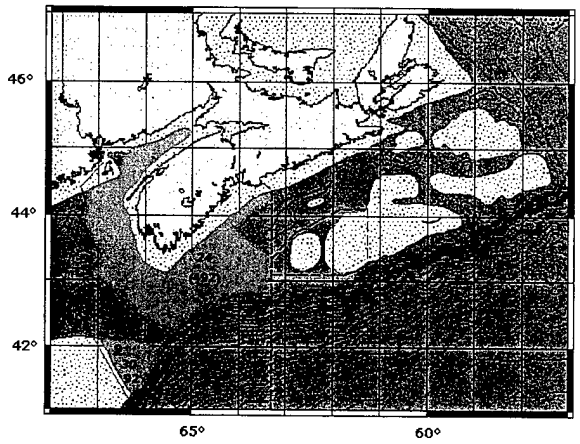

Fig. 2 — Distribution of and numbers of boats fishing for cod and haddock

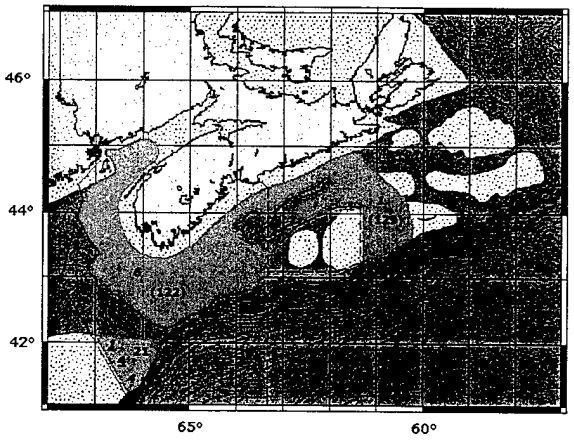

Fig. 3 — Distribution of and numbers of boats fishing for pollock

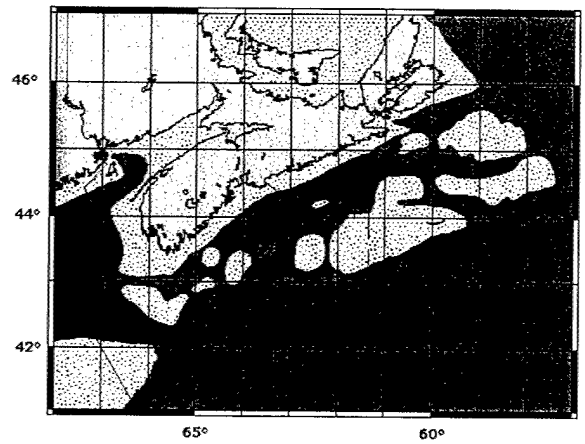

Fig. 4 — Distribution of and numbers of boats fishing for silver hake (orange –larger boats, red –smaller boats)

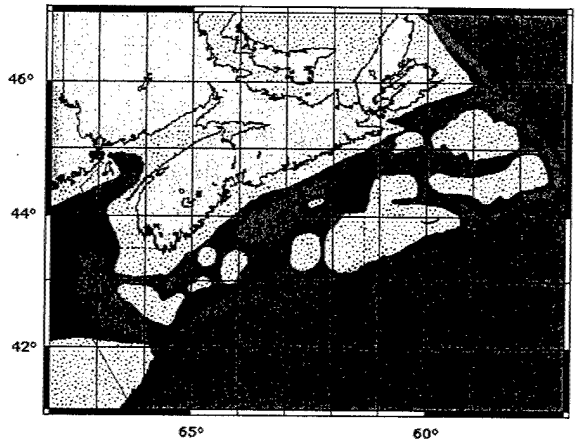

Fig. 5 — Distribution of and numbers of boats fishing for redfish

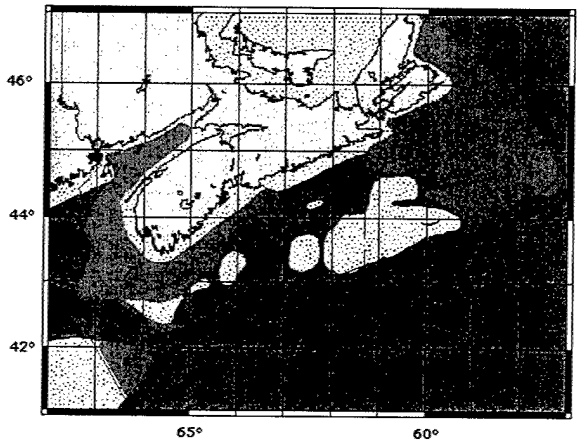

Fig. 6 — Distribution of and numbers of boats fishing for various flatfish species

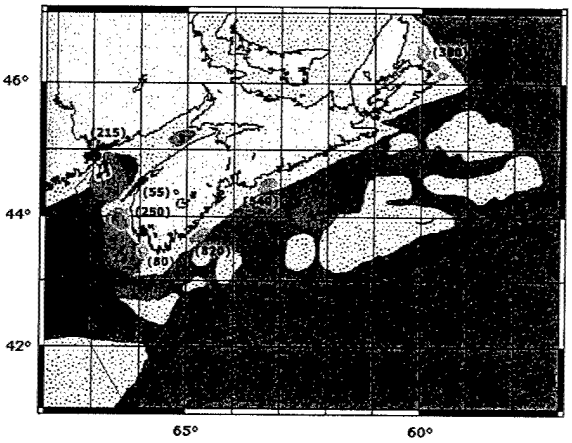

Fig. 7 — Distribution of and numbers of boats fishing for herring (red – weirs and traps; orange – purse seines, purple – gillnets)

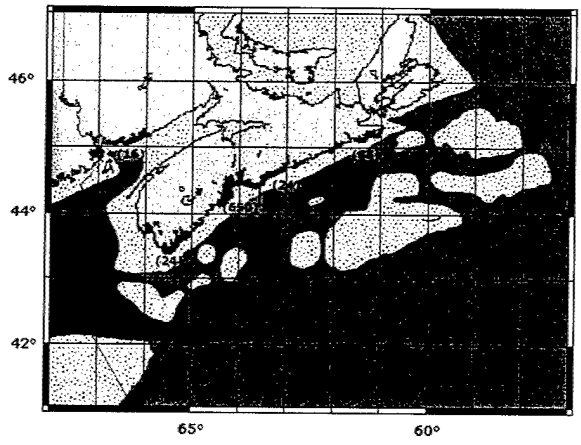

Fig. 8 — Distribution of and numbers of boats fishing for mackerel

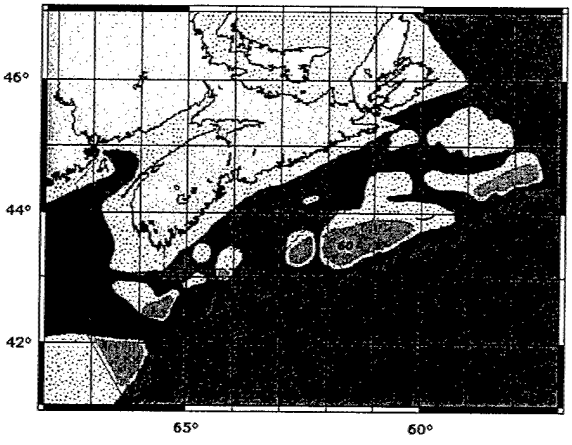

Fig. 9 — Distribution of and numbers of boats fishing for tuna and swordfish (orange –larger boats; purple –smaller boats)

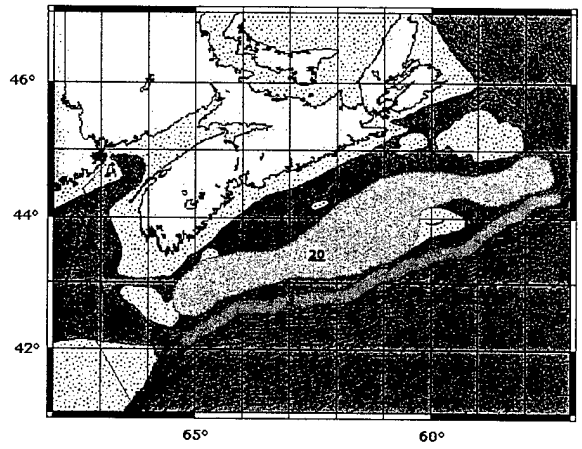

Fig. 10 — Distribution of and numbers of boats fishing for sharks (orange – winter, spring, and fall; purple – summer)

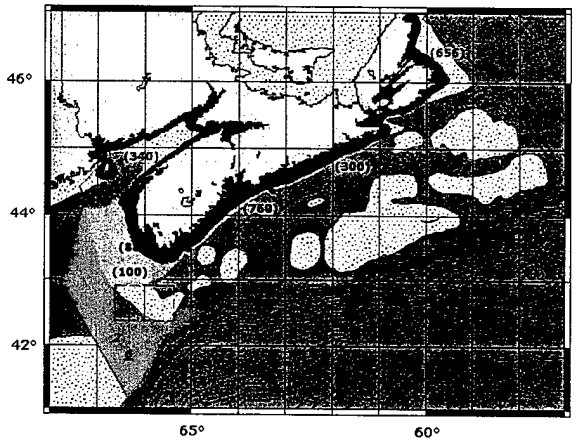

Fig. 11 — Distribution of and numbers of boats fishing for lobster (red – inshore fleet; purple – midshore fleet; orange – offshore fleet)

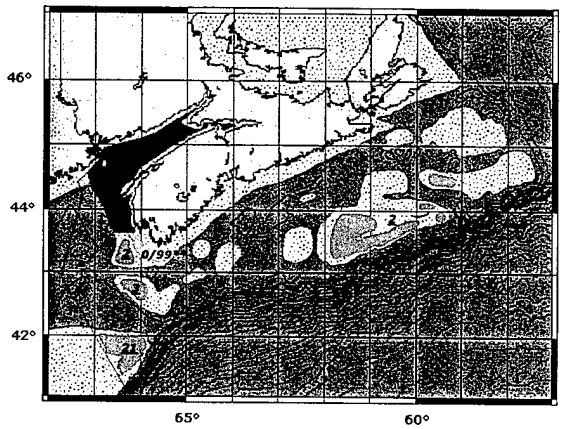

Fig. 12 — Distribution of and numbers of boats fishing for cod and scallops (orange – offshore fleet; red and purple – Bay of Fundy fleet).

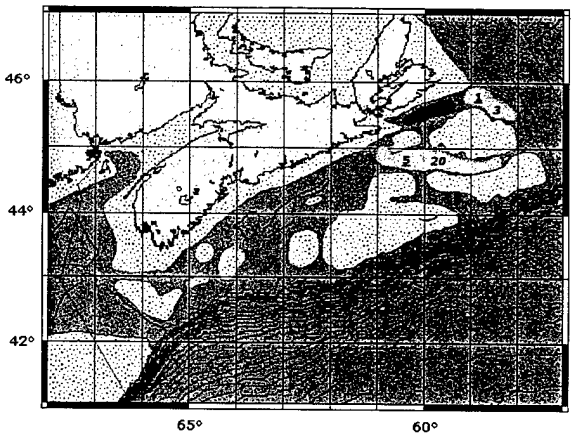

Fig. 13 — Distribution of and numbers of boats fishing for shrimp (red – inshore fleet; purple – offshore fleet)

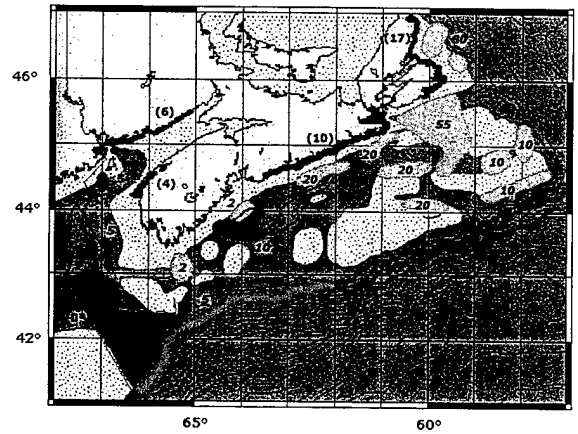

Fig. 14 — Distribution of and numbers of boats fishing for crabs (red – rock crab; purple – snow crab; orange – red crab; maroon – Jonah crab
* Lobster by-catch.

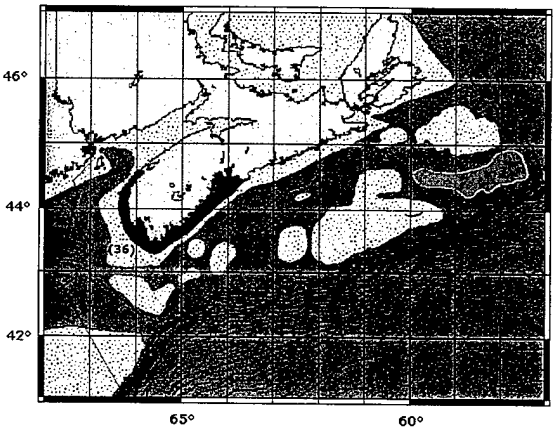

Fig. 15 — Distribution of and numbers of boats fishing for clams (red – inshore fleet; orange – offshore fleet)

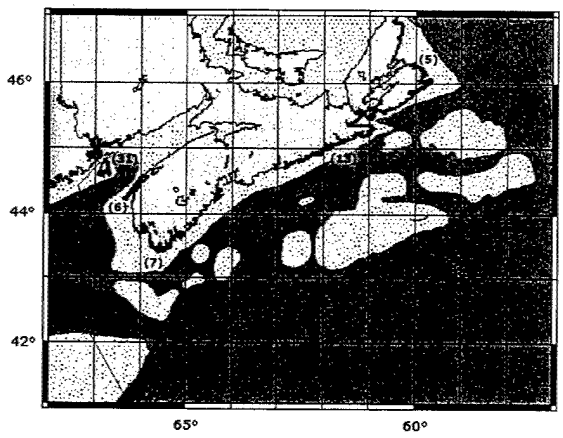

Fig. 16 — Distribution of and numbers of boats fishing for sea urchins

SEASONAL DISTRIBUTION OF FISHING BOATS

The above information on number and sizes of boats, fishing areas and seasons, and catch for each species or species group was analyzed to determine seasonal distributions of fishing boats around Nova Scotia. The analysis was straightforward for a few species, for which all the needed information was available. For other species, the information that was most often missing was the number of days per year boats were at sea. The other important information that was often missing was the seasonal distribution of catch. (Equal CPUEs were assumed to distribute seasonal efforts based on seasonal catches.) For those species for which not all information was available, one or more assumptions or deductions were required. These assumptions and deductions were normally based on information on similar species. In some instances, information for two or more similar species were combined to produce results for each.

Species are listed below in the order in which the analyses were conducted. The easiest species, generally those requiring the fewest assumptions were analyzed first, followed by progressively more difficult species. For each species or species group a paragraph includes available information and the assumptions or deductions that were made. These are followed by calculations giving the total number of days boats of a given size are fishing for that species in a given area and season.

Dividing the total number of boat days by 90 gives the average number of boats of a given size fishing for a given species on any day in a given area and season; which is the desired final result. However, rather than perform this division for each species, it was decided, for arithmetical reasons, to perform it on the total number of days boats of a given size are fishing for all species in a given area and season. This is demonstrated in the next section of the report.

GROUNDFISH

Redfish

28 smaller boats (45'-65') fish about 100 days per year. 5 larger boats (100'-150') fish a maximum 50 days per year. 5% of the days fished are during winter, 40% spring, 40% summer, and 15% fall.

Calculations yield: 13 45'-65' boats on Georges Bank fish 65 days in winter, 520 in spring, 520 in summer, and 195 in fall. 12 45'-65' boats off Cape Breton I. fish 60 days in winter, 480 in spring, 480 in summer, and 180 in fall. 2 45'-65' boats in Emerald and LaHave Basins fish 10 days in winter, 80 in spring, 80 in summer, and 30 in fall. 1 45'-65' boat in Rosemary Basin fishes 5 days in winter, 40 in spring, 40 in summer, and 15 in fall. 3 100'-150' boats off Cape Breton I. fish 8 days in winter, 60 in spring, 60 in summer, and 22 in fall. 2 100'-150' boats off southern Nova Scotia fish 5 days in winter, 40 in spring, 40 in summer, and 15 in fall.

Silver Hake

Fishing is year round. It was assumed that 30 % of the fishing days are in spring, summer and fall and 10% are in winter. It was also assumed that 37 45'-65' boats fish 100 days per year and 5 100'-150' boats fish 50 days per year. [These assumptions are based roughly on redfish.]

Calculations yield: 37 45'-65' boats on Emerald and LaHave Basins fish 370 days in winter, 1110 in spring, 1110 in summer, and 1110 in fall. 5 100'- 150' boats on the shelf edge fish 25 days in winter, 75 in spring, 75 in summer, and 72 in fall.

Cod and Haddock

12 45'-65' trawlers and 54 40'-100' longliners fished for haddock on Georges Bank in summer and fall for about 100 days each and caught 5400 tons, primarily by trawling. 2 45'-65' trawlers and 63 40'-100' longliners fished for cod and caught 1600 tons. The different totals are attributed to the large difference in the number of trawlers fishing for haddock and cod. Therefore, it was assumed that the cod boats also fished 100 days each. The catch on Georges Bank is split 50% for summer and fall.

24 45'-65' trawlers and 492 30'-40' fixed gear boats fished the southern Scotian Shelf and Bay of Fundy for haddock and cod. It was assumed that these boats also fish 100 days per year. More fish are caught in summer, so it was assumed that 40% of the catch was in summer, 25% in spring and fall, and 10% in winter.

Calculations for Georges Bank yield: 92 40'-45' boats fish 4600 days in summer and 4600 in fall. 30 45'-65' boats fish 1500 days in summer and 1500 in fall. 9 65'-100' boats fish 450 days in summer and 450 in fall.

Calculations for the southern Scotian Shelf and Bay of Fundy yield: 492 30'-40' boats fish 5000 days in winter, 12000 in spring, 20000 in summer, and 12000 in fall. 24 45'-65' trawlers fish 240 days in winter, 600 in spring, 960 in summer, and 600 in fall.

Pollock

1 100'-150' boat, 4 65'-100' boats, 11 45'-65' boats, 21 40'-45' boats, and 251 30'-40' boats fish for pollock.

On Georges Bank fishing is limited to summer and fall. Following haddock and cod, it was assumed that each boat fishes 100 days equally split between summer and fall. For the Bay of Fundy and Scotian Shelf, the days fished and seasonal percentages were assumed to be the same as for cod and haddock: 100 days per boat and 40% summer, 25% spring and fall, and 10% winter.

Calculations for the eastern Scotian Shelf yield: 1 trawler 45'-65' fishes 10 days in winter, 25 in spring, 40 in summer, and 25 in fall. 129 boats 30'-40' fish 1300 days in winter, 3200 in spring, 5200 in summer, and 3200 in fall.

Calculations for the southern Scotian Shelf and Bay of Fundy yield: 6 45'-65' boats fish 60 days in winter, 150 in spring, 240 in summer, and 150 in fall. 122 30'-40' boats fish 1200 days in winter, 3000 in spring, 4900 in summer, and 3000 in fall.

Calculations for Georges Bank yield: 1 100'-150' boat fishes 50 days in summer and 50 in fall. 4 65'-100' boats fish 200 days in summer and 200 in fall. 4 45'-65' boats fish 200 days in summer and 200 in fall. 22 40'-45' boats fish 1100 days in summer and 1100 in fall.

Flatfish

The days and seasons fished for cod and haddock were assumed: 100 days per boat, equally split between summer and fall on Georges Bank, and 40% summer, 25% spring and fall, and 10% winter elsewhere.

Calculations for Georges Bank yield: 8 45'-65' trawlers fish 400 days in summer and 400 in fall.

Calculations for Cape Breton I. yield: 6 45'-65' trawlers fish 60 days in winter, 150 in spring, 240 in summer, and 150 in fall.

Calculations for the Bay of Fundy and southern Scotian Shelf yield: 7 45'-65' trawlers fish 70 days in winter, 180 in spring, 280 in summer, and 180 in fall.

PELAGIC FISH

Mackerel

81% of the catch is in June, so it was assumed that 802 30'-40' boats each fish 30 days in June. 11% of the catch is in May, so it is unlikely that the boats fish more than 10 days. 2% of the catch is in each month from July through October; it was assumed that the boats fish 3 days in July and August and 2 in September and October. That is 50 fishing days for each boat.

Calculations yield: For eastern Nova Scotia, 88 30'-40' boats fish 880 days in spring, 3170 in summer, and 350 in fall. For central Nova Scotia east of Halifax, 24 30'-40' boats fish 240 days in spring, 860 in summer, and 100 in fall. For central Nova Scotia west of Halifax, 650 30'-40' boats fish 6500 days in spring, 23400 in summer, and 2600 in fall. For southern Nova Scotia, 24 30'-40' boats fish 240 days in spring, 860 in summer, and 100 in fall. For New Brunswick, 16 30'-40' boats fish 160 days in spring, 580 in summer, and 60 in fall.

Herring

Based on monthly catches, it was assumed that 270 30'-40' boats each fish weirs and traps in Bay of Fundy 20 days in August and September and 10 days in July and October, for a total of 60 days per boat.

Calculations yield: In coastal New Brunswick, 215 30'-40' boats fish 6450 days in summer and 6450 in fall. In coastal Nova Scotia, 55 boats fish 1650 days in summer and 1650 in fall.

Gillnetters, 30'-40', fish 30 nights in fall.

Calculations yield: For Cape Breton I., 360 30'-40' boats fish 10800 days in fall. Near Halifax 540 30'-40' boats fish 16200 days in fall. Near Liverpool 820 30'-40' boats fish 24600 days in fall. South of Yarmouth 80 30'-40' boats fish 2400 days in fall. North of Yarmouth 250 30'-40' boats fish 9000 days in fall.

Based on monthly catches, it was assumed that the 28 40'-45' purse seiners fish 3 weeks in July, August and September, 1 week in June, and 2 weeks in October; or 50 days in summer and 35 days in fall.

Calculations yield: Near Emerald Basin, 4 40'-45' boats fish 200 days in summer and 140 in fall. On Browns Bank, 1 40'-45' boat fishes 50 days in summer and 35 in fall. Off SW Nova Scotia, 13 40'-45' boats fish 650 days in summer and 450 in fall. In the upper Bay of Fundy, 3 40'-45' boats fish 150 days in summer and 100 in fall. In the lower Bay of Fundy, 7 40'-45' boats fish 350 days in summer and 250 in fall.

Sharks

At least 90% of the sharks are caught by 3 100'-150' longline freezer boats fishing the shelf edge for porbeagle in spring and blue sharks in late fall and early winter. Porbeagle constitute 80% of the catch and blue and mako 20%. It was assumed that these boats each fish 100 days. 20 boats 65'-100' catch no more than 10% of the fish over the shelf during the summer and fall. Given the number of boats and the small catch, the 65'-100' boats probably only fish for sharks 5-10 days during the summer.

Calculations yield: For the shelf edge, 3 100'-150' boats fish 240 days in spring, 30 in fall, and 30 in winter. For the shelf, 20 65'-100' boats fish 150 days during the summer.

Swordfish and Tuna

It was assumed that 8 65'-100' boats fish the shelf edge and 60 45'-65' boats fish the banks. It was also assumed that all boats fish 100 days. Based on fishing seasons, 67% of the catch is in summer and 33% in fall.

Calculations yield: For the shelf edge, 8 65'-100' boats fish 530 days in summer and 270 in fall. For all the banks, 60 45'-65' boats fish 4000 days in summer and 2000 in fall. That is 1330 and 670 days on both Sable Island and Georges Banks, 670 and 330 days on Banquereau Bank, 270 and 130 on both Emerald and Browns Banks, and 130 and 70 on LaHave Bank.

SHELLFISH

Shrimp

The 13 very large factory freezer trawlers fish in the far north and are not of concern. The 6 65'-100' trawlers and the 23 45'-65' each fish 941/29 = 32 days each. For the 65'-100' boats, 70% of the effort is in spring and 30% in summer. For the smaller trawlers, 30% of the effort is in spring, 55% in summer, and 15% in fall. Based on lobster and rock crab fleets, it was assumed that the 14 40'-45' boats fish 50 days per year. It was also assumed that their seasonal effort is similar to the smaller offshore boats.

Calculations yield: For the inshore fishery 14 40'-45' boats fish 200 days in spring, 400 in summer, and 100 in fall. For the offshore fishery east of Cape Breton I., 1 65'-100' boat fishes 22 days in spring and 10 in summer; and 3 45'-65' boats fish 72 days in spring, 50 in summer, and 15 in fall. For the offshore fishery south of Cape Breton I., 5 65'-100' boats fish 110 days in spring and 50 in summer; and 20 45'-65' boats fish 200 days in spring, 340 in summer, and 100 in fall.

Lobster

The fishery offshore of SW Nova Scotia is conducted year round by 2 45'-65' boats and 6 100'-150' boats. Highest catches are in November and December so it was assumed that 40% of the catch is in winter, 25% in spring and fall, and 10% in summer. Combining information on offshore lobster and scallop fleets, it was assumed that these boats fish 100 days per year. In Cape Breton I., it was assumed that 656 30'-40' inshore boats fish 25 days from mid-May to mid-June. In eastern Nova Scotia, 300 30'-40' inshore boats fish 50 days in April, May and June; 2/3 spring and 1/3 summer. In southern Nova Scotia, 760 30'-40' inshore boats fish 50 days a year from December through May, with more than 1/2 of the catch in December. It was assumed that 2/3 of the effort is in winter and 1/3 in spring. In SW Nova Scotia, 880 30'-40' inshore boats and 100 30'-40' midshore boats fish 50 days per year. It was assumed that 2/3 of the effort is in winter and 1/3 in spring. In the Bay of Fundy, 340 30'-40' inshore boats fish 50 days from October through July, with different seasons in 3 different areas. Based on these seasons, it was assumed that 30% of the effort is in winter, 35% in spring, 20% in summer, and 15% in fall.

Calculations yield: For the offshore fleet, 2 45'-65' boats fish 80 days in winter, 50 in spring, 20 in summer, and 50 in fall; and 6 100'-150' boats fish 240 days in winter, 150 in spring, 60 in summer, and 150 in fall. For Cape Breton I., 656 30'-40' boats fish 8200 days in spring and 8200 in summer. For eastern Nova Scotia, 300 30'-40' boats fish 10000 days in spring and 5000 in summer. For southern Nova Scotia, 760 30'-40' boats fish 25000 days in winter and 13000 in spring. For SW Nova Scotia, 880 30'-40' inshore boats fish 30000 days in winter and 15000 in spring, and 100 30'-40' midshore boats fish 3300 days in winter and 1700 in spring. In the Bay of Fundy, 340 30'-40' boats fish 5100 days in winter, 6000 in spring, 3400 in summer, and 2500 in fall.

Scallops

The offshore fishery is conducted year round by 28 100'-150' boats. Combining information on offshore lobster and scallop fleets, it was assumed that these boats fish 100 days per year. 2/3 of these days are in spring and summer and 1/3 in fall and winter. Browns Bank is only open in summer and fall, but since boat distributions are based on equal CPUEs, 100 days per year were still assumed, with 2/3 of the days in summer and 1/3 in fall. The 99 45'-65' boats fish 50 days a year, 20 days in summer south of 43°40'N, 10 in fall between 44°20'N and 43°40'N, and 10 each in winter and spring in the Bay of Fundy. It was assumed that the 226 30'-40' boats in the Bay of Fundy fish 50 days a year, with 25% in each season.

Calculations yield: For the eastern Scotian Shelf, 2 100'-150' boats fish 33 days in winter, 67 in spring, 67 in summer, and 33 in fall. For German Bank, 2 100'-150' boats fish 33 days in winter, 67 in spring, 67 in summer, and 33 days in fall. For Browns Bank, 3 100'-150' boats fish 200 days in summer and 100 in fall. For Georges Bank, 21 100'-150' boats fish 350 days in winter, 700 in spring, 700 in summer, and 350 in fall. For the Bay of Fundy, 226 30'-40' boats fish 2800 days in winter, 2800 in spring, 2800 in summer, and 2800 in fall; these boats fish north of 44°20'N. Also for the Bay of Fundy, 99 45'-

65' boats fish 1000 days in winter and 1000 in spring north of 44°20'N. For SW Nova Scotia, 99 45'-65' boats fish 2000 days in summer south of 43°40'N and 1000 in fall between 44°20'N and 43°40'N.

Sea Urchins

It was assumed that the 62 30'-40' boats fish 50 days per year. In New Brunswick, 45% of the catch is in winter, 30% in spring, and 25% in fall. In Nova Scotia, 20% of the catch is in spring and 40% each in fall and winter.

Calculations yield: For New Brunswick, 31 30'-40' boats fish 700 days in winter, 460 in spring, and 390 in fall. For Cape Breton I., 5 30'-40' boats fish 100 days in winter, 50 in spring, and 100 in fall. For eastern Nova Scotia, 13 30'-40' boats fish 260 days in winter, 130 in spring, and 260 in fall. For SW Nova Scotia, 7 30'-40' boats fish 140 days in winter, 70 in spring, and 140 in fall. For western Nova Scotia, 6 30'-40' boats fish 120 days in winter, 60 in spring, and 120 in fall.

Clams

Based on the days at sea for the large offshore shrimp freezer trawlers, it was assumed that the 3 200' offshore clam boats fish year round 240 days per year. It was assumed that the inshore fishery is conducted by 36 30'-40' boats that fish 50 days a year, 25% in each season.

Calculations yield: For Banquereau Bank, 3 200' boats fish 180 days in winter, 180 in spring, 180 in summer, and 180 in fall. For the inshore fishery in southern Nova Scotia, 36 30'-40' boats fish 450 days in winter, 450 in spring, 450 in summer, and 450 in fall.

Crabs

The red crab fishery is conducted by 5 100'-150' boats. Comparison with the offshore lobster fishery indicates that these boats fish 100 days a year. 5% of the effort is in winter, 30% in spring, 35% in summer, and 30% in fall.

Calculations for red crabs yield: Offshore, 5 100'-150' boats fish 25 days in winter, 150 in spring, 175 in summer, and 150 in fall.

The rock crab fishery is inshore and conducted by 30'-40' boats. In Cape Breton I., 17 boats fish 75 days per year each, 50% in fall, 33% in summer, and 17% in winter. In eastern Nova Scotia, 10 boats fish 40 days per year each, 50% in fall, 33% in summer, and 17% in winter. In the Bay of Fundy, it was assumed that the boats fish 50 days per year each, 70% in summer and 30% in fall; of the 10 boats, 6 fish the New Brunswick side and 4 fish the Nova Scotia side.

Calculations for rock crabs yield: Cape Breton I., 17 30'-40' boats fish 210 days in winter, 425 in summer, and 640 in fall. In eastern Nova Scotia, 10 30'-40' boats fish 70 days in winter, 130 in summer, and 200 in fall. In the Bay of Fundy, 10 30'-40' boats fish 350 days in summer and 150 in fall.

The snow crab fishery is conducted in relatively deep water by boats that were assumed to be 45'-65'. In SW Nova Scotia, 4 boats fish about 60 days per year each, 14% in fall, 42% in winter, and 42% in spring; effort is split between Roseway Basin and LaHave Basin. Off eastern Nova Scotia and Cape Breton I., it was assumed that boats fish 60 days each, that the season is split equally between summer and fall, and that boats in a region are split based on the sizes of the fishing areas in the region. In eastern Nova Scotia, 82 boats, equally split, fish north of Emerald Basin, south of Canso, north of Middle Bank, and north of Sable Island Bank. Off southern Cape Breton I., 55 boats fish south of Louisbourg and 10 boats fish each of the three areas around Banquereau Bank. 80 boats fish off NE Cape Breton I.

Calculations for snow crabs yield: Near Roseway Basin, 2 45'-65' boats fish 50 days in winter, 50 in spring, and 20 in fall. Near LaHave Basin, 2 45'-65' boats fish 50 days in winter, 50 in spring, and 20 in fall. In eastern Nova Scotia, 20 boats north of Emerald Basin, 20 south of Canso, 20 north of Middle Bank, and 20 north of Sable Island Bank, all 45'-65', fish 600 days in summer and 600 in fall in each area. South of Cape Breton I., 55 45'-65' boats fish 1650 days in summer and 1650 in fall south of Louisbourg, and 30 45'-65' boats fish 900 days in summer and 900 in fall around Banquereau Bank. Off NE Cape Breton I., 80 45'-65' boats fish 2400 days in summer and 2400 in fall.

The offshore Jonah crab fishery is conducted by 8 lobster boats catching crabs as by-catch. Thus, these boats have already been accounted for. SW of Halifax, 10 boats, that were assumed to be 45'-65', fish for Jonah crab 20 days per year each, equally split between summer and fall. Near Jordan Basin, 5

boats, that were also assumed to be 45'-65', fish for Jonah crab 20 days per year each, 60% in summer and 40% in fall. Near Grand Manan I., 5 boats, which were assumed to be 40'-45', fish for Jonah crab 20 days per year each, 60% in summer and 40% in fall.

Calculations for Jonah crabs yield: SW of Halifax, 10 45'-65' boats fish 100 days in summer and 100 in fall. Off SW Nova Scotia, near Jordan Basin, 5 45'-65' boats fish 60 days in summer and 40 in fall. Near Grand Manan I., 5 40'-45' boats fish 60 days in summer and 40 in fall.

AN EXAMPLE DISTRIBUTION: SOUTH OF HALIFAX IN THE FALL

Summing the average number of boats fishing for all species in an area and season is not straightforward. Since different species are caught in areas that may or may not overlap, the summation process depends on how the result is going to be used. In this section of the report, an example summation is shown for application to an experiment conducted in the fall south of Halifax near Emerald and LaHave Basins.

The first step in this example is to divide the region into small areas based on bathymetry and species distributions. Seven coastal, eight shelf, and six slope areas were chosen, as shown in Figure 17. The seven coastal areas were designated as the southwest coast (SWC), the western coast (WC), the west central coast (WCC), the central coast (CC), the east central coast (ECC), the eastern coast (EC), and the southern Cape Breton I. coast (CBC). The eight shelf areas were designated as Georges Bank (GB), Browns Bank (BRB), LaHave Bank (LHB), LaHave and Emerald Basins (LHEB), Emerald Bank (EB), Sable I. Bank (SIB), Middle Bank (MB), and Banquereau and Misaine Banks (BMB). The six slope areas were designated as Georges Bank slope (GBS), western slope (WS), central slope (CS), east central slope (ECS), eastern slope (ES), and Laurentian slope (LS). Since boats near the experiment site will have more influence than those farther away, areas near the site are generally smaller than those farther away. Boats north of a line drawn northeast from the southeastern tip of Cape Breton I. will have no influence on the experiment and are ignored. Boats north of a line drawn west southwest from the tip of SW Nova Scotia are also ignored. (Note that, for example, although boats in the Bay of Fundy can be ignored for this example, they had to be included initially to produce the proper geographic distributions.)

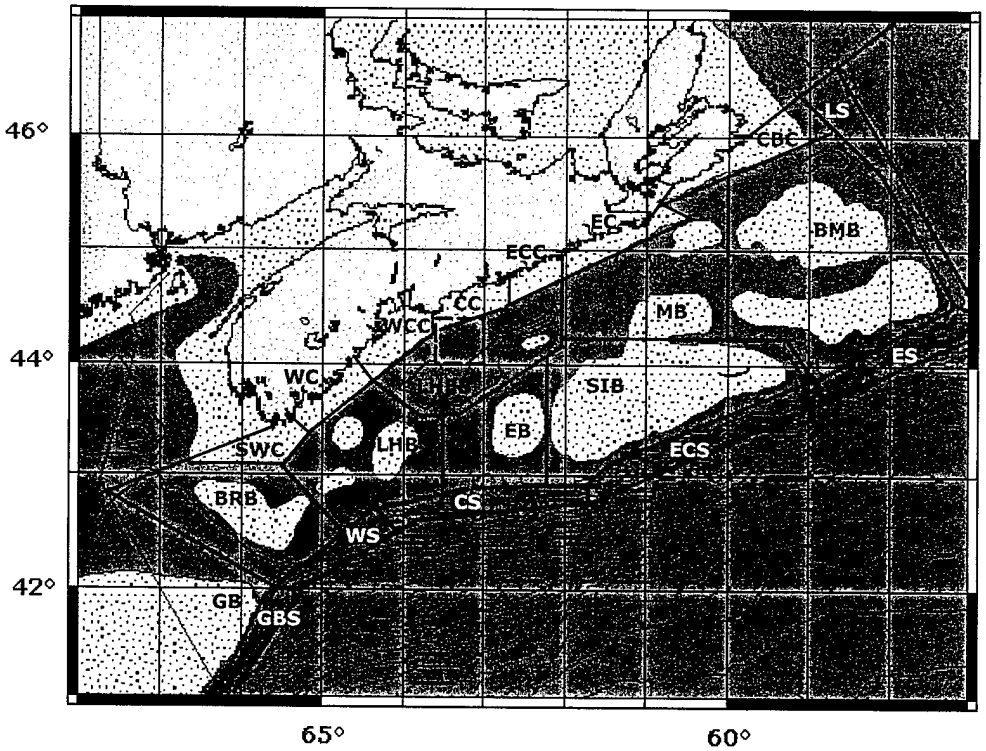

Fig. 17 — Areas for example summation of fishing boats

Tables 3, 4 and 5 show fishing boat distributions in the fall for the selected coastal, shelf, and slope areas, respectively. In each case, the number of boat days for a given species, boat size, and area are shown first. Then the total boat days for a given boat size and area for all species are shown. These totals are then divided by 90 to give the average number of boats of a given size that are estimated to be in a given area on any day during the fall.

Table 3. Fishing boat numbers for fall in the coastal areas of Fig. 19

SPECIES/ BOAT SIZE	SWC	WC	WCC	CC	ECC	EC	CBC		
Cod/Haddock									
30'-40'	1000	0	0	0	0	0	0		
Pollock									
30'-40'	300	0	0	0	0	0	0		
Flatfish									
30'-40'	10	0	0	0	0	0	0		
Mackerel									
30'-40'	50	50	2600	100	0	350	0		
Herring									
30'-40'	0	24600	0	16200	0	0	0		
40'-45'	50	0	0	0	0	0	0		
Scallops									
45'-65'	500	0	0	0	0	0	0		
100'-150'	15	0	0	0	0	0	0		
Sea Urchins									
30'-40'	60	60	0	0	100	160	50		
Clams									
30'-40'	50	100	100	0	0	0	0		
Crabs									
30'-40'	0	0	0	60	60	80	160		
45'-65'	0	0	0	0	0	0	240		
TOTALS									
30'-40'	160	24810	2700	16360	160	590	210		
40'-45'	50	0	0	0	0	0	0		
45'-65'	500	0	0	0	0	0	240		
100'-150'	15	0	0	0	0	0	0		
AVERAGE # BOATS									**ALL AREAS**
30'-40'	1.8	276	30	182	1.8	6.6	2.3		500
40'-45'	0.6	0	0	0	0	0	0		0.6
45'-65'	5.6	0	0	0	0	0	2.7		8.2
100'-150'	0.2	0	0	0	0	0	0		0.2

Table 4. Fishing boat numbers for fall in the shelf areas of Fig. 17

SPECIES/ BOAT SIZE	GB	BRB	LHB	LHEB	EB	SIB	MB	BMB		
Redfish										
45'-65'	70	75	10	30	0	0	0	0		
Silver Hake										
45'-65'	0	0	0	1110	0	0	0	0		
Cod/Haddock										
30'-40'	0	1000	1500	1500	0	0	0	0		
40'-45'	4600	0	0	0	0	0	0	0		
45'-65'	1500	160	240	0	0	0	0	0		
65'-100'	450	0	0	0	0	0	0	0		
Pollock										
30'-40'	0	100	600	2000	0	0	1600	0		
40'-45'	1100	0	0	0	0	0	0	0		
45'-65'	200	50	70	0	0	15	10	0		
65'-100'	200	0	0	0	0	0	0	0		
100'-150'	50	0	0	0	0	0	0	0		
Flatfish										
45'-65'	400	35	25	20	0	0	30	110		
Herring										
40'-45'	0	35	0	70	70	0	0	0		
Swordfish/Tuna										
45'-65'	670	130	70	0	130	670	0	330		
Shrimp										
40'-45'	0	0	0	0	0	0	50	50		
45'-65'	0	0	0	0	0	0	40	75		
Lobster										
45'-65'	25	10	0	0	0	0	0	0		
100'-150'	70	35	0	0	0	0	0	0		
Scallops										
100'-150'	350	100	0	0	0	30	0	3		
Clams										
200'	0	0	0	0	0	0	0	180		
Crabs										
45'-65'	0	0	90	500	0	600	1900	2000		
TOTALS										
30'-40'	0	1100	2100	3500	0	0	1600	0		
40'-45'	5700	35	0	70	70	0	50	50		

45'-65'	2865	460	505	1660	130	1285	1980	2515		
65'-100'	650	0	0	0	0	0	0	0		
100'-150'	470	135	0	0	0	30	0	3		
200'	0	0	0	0	0	0	0	180		
AVERAGE # BOATS										**ALL AREAS**
30'-40'	0	12	23	39	0	0	18	0		92
40'-45'	63	0	0	0.8	0.8	0	0.6	0.6		66
45'-65'	32	5.1	5.6	18	1.4	14	22	28		127
65'-100'	7	0	0	0	0	0	0	0		7
100'-150'	5.2	1.5	0	0	0	0	0	0		7
200'	0	0	0	0	0	0	0	2.0		2

Table 5. Fishing boat numbers for fall in the slope areas of Fig. 17

SPECIES/ BOAT SIZE	**GBS**	**WS**	**CS**	**ECS**	**ES**	**LS**		
Redfish								
45'-65'	0	0	0	0	50	100		
100'-150'	0	4	10	1	6	12		
Silver hake								
100'-150'	0	20	32	20	0	0		
Sharks								
100'-150'	0	6	8	10	6	0		
Swordfish/Tuna								
65'-100'	40	40	60	70	60	0		
Crabs								
100'-150'	50	50	50	0	0	0		
TOTALS								
45'-65'	0	0	0	0	50	100		
65'-100'	40	40	60	70	60	0		
100'-150'	50	80	100	31	12	12		
AVERAGE # BOATS								**ALL AREAS**
45'-65'	0	0	0	0	0.6	1.1		1.7
65'-100'	0.4	0	0.7	0.8	0.7	0		3.0
100'-150'	0.6	0.9	1.1	0	0	0		3.2

Almost all the boats in coastal areas are less than 40'; 90% of these small boats fish for herring. Boat numbers vary widely among areas, from about 280 along the western coast to about 2 along the east central coast. Four of the areas contain less than 10 boats and two contain well over 100.

The few boats fishing along the slope relatively large; none are less than 45' and 75% are between 65' and 150'. These boats are evenly distributed, with numbers only ranging from 0.8 on the east central slope to 1.8 on the central slope.

Boats from 30' to 200' fish the shelf, about 65% of them are between 40' and 65'. Boat numbers range from about 2 on Emerald Bank to 107 on Georges Bank, but numbers for the other six areas only range from 14 to 60.

Table 6 summarizes the fall fishing boat distributions. Not surprisingly, most of the boats are small and fish along the coast. Only 1% of the boats fish the slope and only 3% are longer than 65'.

Table 6. Fall fishing boat distributions in the three geographic areas

BOAT SIZE	Coast	Shelf	Slope	Total
30'-40'	500	92	0	592
40'-45'	0.6	66	0	66.6
45'-65'	8.2	127	1.7	136.9
65'-100'	0	7	3	10
> 100'	0.2	9	3.2	12.4
Total	509	301	8	818

FISHING BOAT LENGTH, TONNAGE, AND HORSEPOWER

The noise generated by a transiting ship is related to its speed and the maximum speed of a displacement vessel is related to its waterline length. Thus, for commercial vessels such as freighters and tankers, ship noise can be related to ship length. However, while fishing, fishing boats are seldom travelling at maximum speed, so that waterline length is probably not a good predictor of fishing boat noise. Horsepower may be a better predictor, particularly for trawlers and seiners. This section of the report relates fishing boat length, gross registered tonnage (GRT) and horsepower.

FAO's Fishery Fleet Statistics includes tables that give the number of boats in different length ranges and the total tonnage of those boats for different countries. Not all countries have provided this data to FAO. For example, for North and South America, only El Salvador, Chile, the Falkland Islands, and Venezuela have provided such data. Data from ten representative countries was used to establish a relationship between boat length and tonnage. These countries ranged from major fishing countries such as Russia and Spain, to countries with very small fishing fleets, such as India and New Caledonia.

Dividing the total tonnage by the number of boats in a length range gives the average tonnage of boats in that length range. It was assumed that the average tonnages correspond to the medians of the length ranges. Figure 18 shows the resulting length versus tonnage curves for the ten chosen countries. (Note that FAO boat lengths are in meters, while DFO lengths are in feet.) Results for all countries are similar except at the two smallest lengths, that is, for boats $\leq$ 9 m, or 30', which is the lower limit of Canadian boat lengths considered above. Also shown in Figure 18 are an average curve and a power law fit to the data. The power law relation between boat length (L) and tonnage is GRT = 0.04 $L^{2.5}$. where L is in meters.

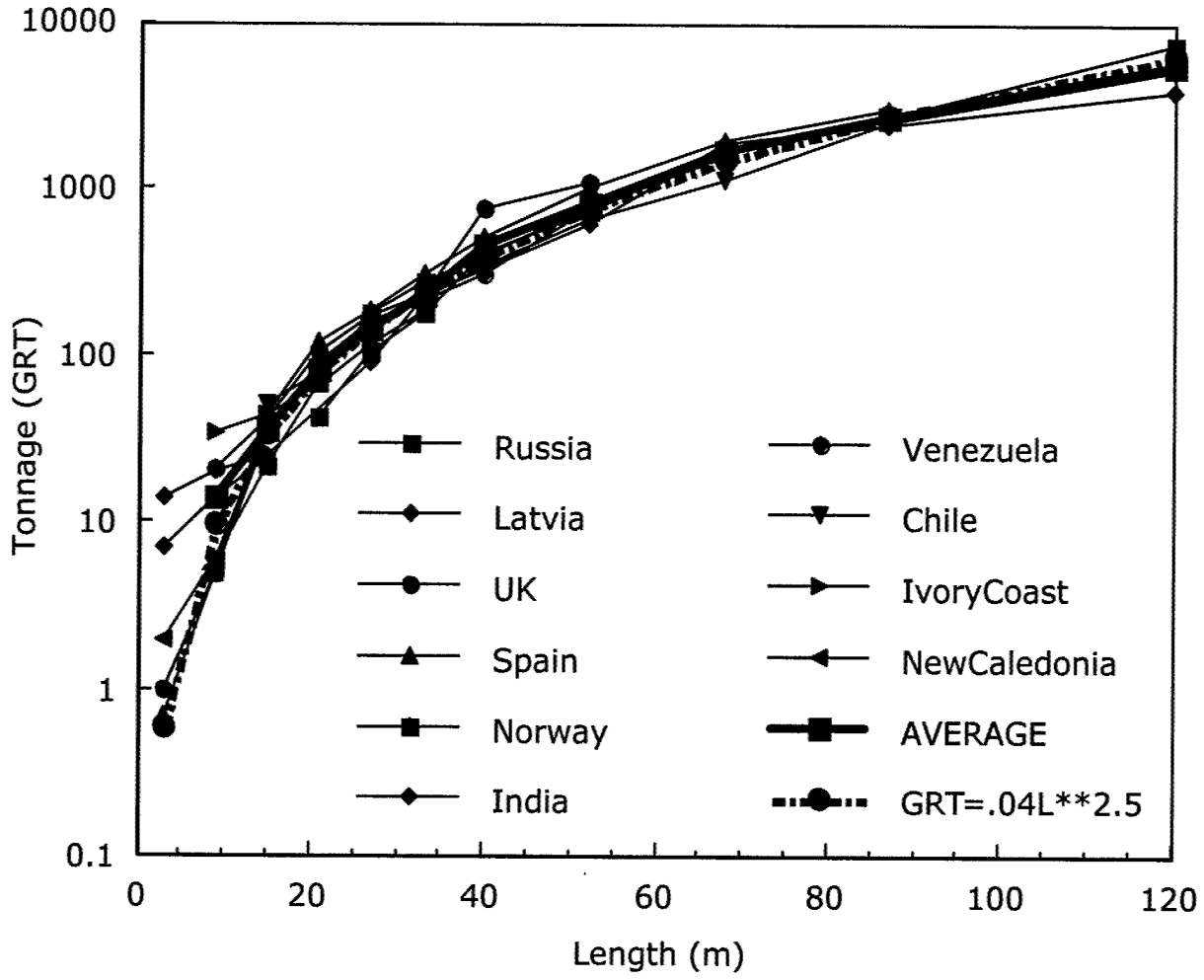

Figure 18 - Fishing boat length versus tonnage.

FAO's Fishery Fleet Statistics also includes tables that provide horsepower data on boats in different countries. Even fewer countries have provided this data than provided length/tonnage data. Only five of the ten countries whose data were used to establish the tonnage/length ratio provided horsepower data. The data from these five countries were used to establish a relationship between tonnage and horsepower.

The FAO tables give the number of boats in different horsepower ranges and the total horsepower of those boats but do not relate horsepower to boat length or tonnage. Thus, to develop a relationship between tonnage and horsepower, cumulative distributions of tonnage and horsepower were calculated for each country. Using these cumulative distributions, it was assumed that, if $X\%$ of the boats have a tonnage less than T and if $X\%$ have a horsepower less than H, then boats of tonnage T have horsepower H. Following this procedure for a number of cumulative percentages produced the tonnage/horsepower curves shown in Figure 19. Also shown in Figure 19 are two straight line segments that are approximate fits to the data. They are, for $1 \leq GRT \leq 10$, $HP = 10\ GRT$, and, for $10 \leq GRT \leq 10000$, $HP = 21.5\ GRT^{2/3}$.

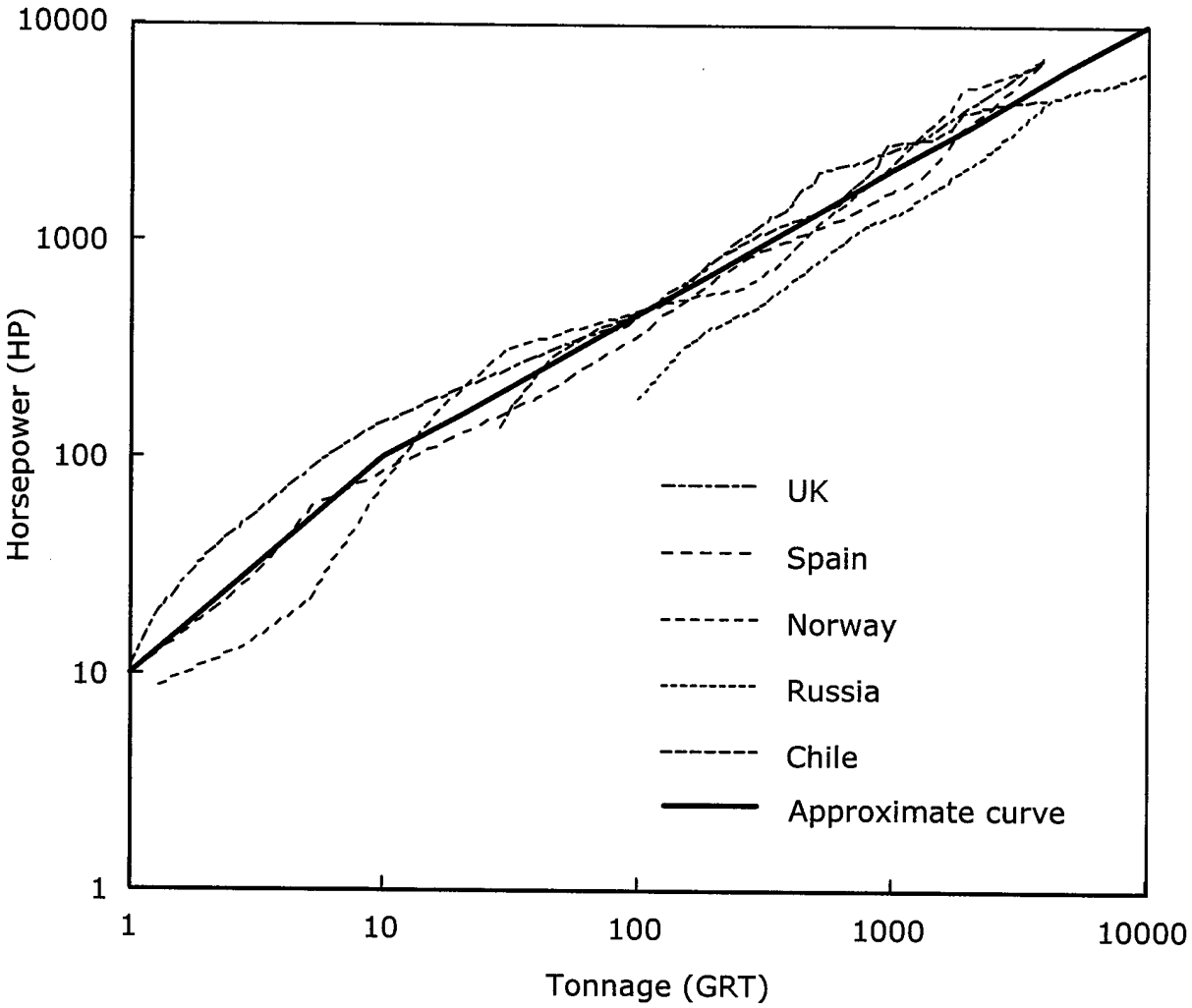

Figure 19 - Fishing boat tonnage versus horsepower. Approximate curve is: HP = 10 GRT for $1 \le GRT \le 10$ and HP = 21.5 $GRT^{2/3}$ for $10 \le GRT \le 10000$.

Table 7 gives tonnage and horsepower for boats fishing around Nova Scotia. Boat lengths given correspond to the minimum, average, and maximum lengths of the modified DFO boat ranges used in this study. A comparison with Table 6 shows that most of the boats fishing in the fall are powered by engines between 100 and 200 HP.

Table 7. Tonnage and horsepower for fishing boats around Nova Scotia

L (ft)	L (m)	GRT	HP
30	9	10	100
35	11	15	131
40	12	21	164
43	13	25	184
45	14	28	198
55	17	46	276
65	20	70	366
82	25	125	538
100	30	205	749
125	38	360	1090
150	46	570	1481
200	61	1170	2393

ACKNOWLEDGMENTS

The authors wish to acknowledge support from SPAWAR PMW 155, Mr. Kim Koehler, and the Office of Naval Research, Program Element 63207N.

REFERENCES

1. Bradley, M. and Emery, L. "Software Design Description (SDD) for the HITS Vessel Motion Simulation (HVMS)," Planning Systems Incorporated, TRS-299 (2001).

2. Emery, L., Bradley, M. and Hall, T. "Data Base Description (DBD) for the Historical Temporal Shipping Data Base (HITS), version 4.0," Planning Systems Incorporated, TRS-301 (2001).

APPENDIX A - DFO SPECIES NOTES ON GROUNDFISH

GENERAL NOTES FROM THE GROUNDFISH MANAGEMENT PLAN FOR THE SCOTIA-FUNDY REGION

The groundfish fishery is conducted by a wide range of vessels ranging from small inshore fixed gear boats to large offshore trawlers. In 1999/2000, the fixed gear fleet had the following numbers of issued/active licenses: (a) boats < 45': in Eastern Nova Scotia – 796/129, in SW Nova Scotia – 1743/707, in SW New Brunswick – 225/47; (b) boats 45'-65': 62/20; (c) boats 65'-100': 13/11. Fixed gear includes handlines, longlines, and gillnets. In 1999/2000, the mobile gear fleet had the following numbers of issued/active licenses: (a) boats < 65': 422/131; (b) boats 65'-100': 2/2; (c) boats > 100': 43/33. Mobile gear for groundfish seems to include only otter trawls. The inshore fleets consist of boats < 65'; midshore fleets are 65'-100'; and offshore fleets are > 100'. The Scotia-Fundy based large trawler fleet fishes in waters outside the region.

There are over 100 groundfish processing plants in the Scotia-Fundy region.

The eastern Scotian Shelf fisheries for cod and haddock have been closed since 1993. Fixed gear fleets in this area fish mainly for pollock and halibut. The inshore mobile gear fleet fishes for pollock, flatfish, and redfish; while the offshore fleet concentrates on redfish and pollock.

The western Scotian Shelf is fished by both fixed and mobile inshore fleets. An exception is the pollock fishery, which has a large offshore fleet presence.

Georges Bank is fished primarily by inshore fleets. Cod and haddock were the main species historically, but now there is also an expanding yellowtail flounder fishery.

The fisheries in Areas 4X and 5Z are very complex with many different fleet components and gear types fishing a spectrum of species.

The groundfish fishery in this region takes place throughout the year, with various fleets adjusting the timing of their fisheries based on local abundance, weather, market conditions, and interactions with other fisheries. Georges Bank is closed from January 1 through May 31 during pre-spawning/spawning. January through March is the least active fishing period.

Many directed groundfish fisheries catch significant by-catches of many other species. By-catch quotas of scarce species can limit the catches of more abundant species. Groundfish are also caught by other fisheries, such as the scallop fishery. The by-catch issue can be confusing.

<u>Closed Areas</u>

Browns Bank is closed from February 1 through June 15.

Georges Bank is closed to all boats > 100' from February 1 through March 31.

Rosemary Bank is closed year round to all boats except the Fixed Gear 65'-100' fleet. Any boat may fish there if they carry an observer.

Area 4V and 4W "Juvenile Area" is closed year round.

Area 4Vsb is closed January 1 through April 30.

There is no directed fishery for skate.

<u>Additional Specific Vessel Class Requirements</u>

Fixed < 45': (a) Areas 4V and 4W – fish only for pollock and halibut; (b) Areas 4X and 5Y – fish only for cod, haddock, pollock and halibut; (c) no directed fishing for cusk, white hake, or monkfish.

Fixed 45'-65': (a) Areas 4V and 4W – fish only for pollock and halibut; (b) Areas 4X and 5Y – fish only for cod, haddock, pollock and halibut; (c) no directed fishing for cusk, white hake, dogfish, shark, or monkfish; (d) Area 4W "Nursery Area" closed year round; (e) No gill nets in Area 4Vsb and the "Shelburne Area" year round; (f) boats can fish either Area 4Vs and 4W or Area 4X and 5Y – can't switch areas without permission.

Fixed 65'-100': No gillnets allowed.

Mobile < 65': (a) Fish only for cod, haddock, pollock, flatfish, and redfish – other species require a separate license; (b) no directed fishing for cusk; (c) open seasons are – year round for redfish in Areas 4X and 5Y and pollock in Areas 4Vs and 4W and July 1 through December 31 for redfish in Areas 4Vs and 4W.

Mobile 65'-100': no directed fishing for white hake.

All > 100: no directed fishing for white hake.

COD

Eastern Scotian Shelf (Areas 4Vs and 4W)

Historically, there have been major spawning groups on Western/Sable and Banquereau Banks; smaller ones on Middle and Canso Banks; and even smaller coastal spawning groups. The Canadian offshore trawler fleet accounted for 70-75% of the catch and longliners most of the rest. From 1980 to 1993, 60-80% of the catch from this area came from Area 4Vs.

The directed cod fishery in this area has been closed since September 1993. By-catches since 1997 have been 200-400 tons, pretty evenly divided between Areas 4Vs and 4W. Surveys in the fall of 1995-1997 showed many of the cod were on Western, Sable and Emerald Banks in Area 4W, with concentrations in nearshore areas also. In 1998, the short term outlook for this fishery was called "dismal".

Southern Scotian Shelf and Bay of Fundy (Areas 4X and 5Y)

In 2000, 6000 tons of cod were caught in this area. The fishery takes place year round, peaking in June and July. The largest spawning concentration is on Browns Bank during winter; consequently Browns Bank is closed from 1 February until 15 June. Due to low quotas, many treat cod as by-catch while pursuing other species. In 1999, the inshore fishery was good for the first time in 4 years. In 2000, fishers had no trouble catching their quotas, although many were directing their effort primarily at haddock. The number of vessels using fixed gear declined from 1996 through 2000, while catch rates for gillnet and longline vessels increased in 2000 to the highest levels in 5 years. In 2000 and 2001, fishing was good in most areas. Hook and line vessels in the Bay of Fundy caught their quota for the first time in 4 years. However, fishing in the inshore areas of Area 4X (SE coast from about Mill Village to Tusket) was poor; fishers had to travel farther offshore to catch fish. The outlook for this fishery is that biomass should continue to increase.

Eastern Georges Bank (Area 5Z)

In 2000, Canadians caught 1600 tons in this area, slightly less than in 1999 (1800) and 1998 (1900). The Canadian groundfish fishery in this area has been closed to all vessels from January to June since 1994. Cod are caught primarily between June and October. Fishing gear includes longline, mobile gear, and gillnets; catches are now dominated by fixed gear. There is high cod by-catch in haddock directed trips. The outlook indicates that a combined Canadian/US catch around 2000-3000 tons should sustain present biomass.

HADDOCK

Eastern Scotian Shelf (Areas 4V and 4W)

The majority of haddock in this area occur on offshore banks, ranging from Emerald to Banquereau. Haddock prefer hard sand or gravel bottoms at depths from about 50 to 350 m. During summer, haddock are on top of the banks; in winter they move to deeper water to avoid cold temperatures. Spawning occurs in spring on the banks.

The directed haddock fishery in these areas has been closed since the fall of 1993. By-catch of haddock in these areas in 2000 was 71 tons. Also, the "haddock box", encompassing mainly Emerald and Western Banks, has been closed to all groundfishing since 1987. Recent surveys (September 1999 and 2000) indicate that most haddock are within the "box" and around its perimeter; smaller amounts were

found along the flanks of Sable and Banquereau Banks and the Gully. The outlook for this stock is iffy; it could grow or remain the same.

Traditionally, mobile (otter trawls) and fixed gear were used to catch haddock. Otter trawls dominated in both areas.

Southern Scotian Shelf and Bay of Fundy (Areas 4X and 5Y)

A major haddock stock exists on the southern Scotian shelf and in the Bay of Fundy. The fish are most common between 50 and 140 m. (Note difference with above.) Browns Bank is the major spawning area; peak spawning occurs from April to June. A spawning season/area closure has been in effect since 1970.

In 1998, 7843 tons were caught; 5234 with mobile gear and 2608 with fixed gear. Most haddock fishers try to avoid cod; the first quarter of the year is the best time to catch haddock without catching cod.

The stock is evenly distributed over the area (within its depth range). Its outlook is good, it's rebuilding.

Eastern Georges Bank (Area 5Z)

A major concentration of haddock exists on eastern Georges Bank. Haddock are most commonly caught between 45 and 240 m. (Note differences with above.) Spawning season/area closures have been in place since the early 1970s. All groundfish fisheries on Georges Bank are closed from January to early June.

Traditionally, bottom trawling has been the principal gear. Recently, fishing has been conducted primarily using otter trawls and longlines, with some handlines and gillnets. In 2000, most fish were caught by otter trawlers and longliners < 65', but boats > 65' also fished. Catches by trawlers peaked in June and those by longliners peaked in September. Gill netters caught few fish. Overall in 2000, 5400 tons were caught in 620 trips. USA day/trip limits indicate that USA boats fish for about 10 days/trip.

The outlook for this stock is for it to slowly increase.

POLLOCK

The main fishable concentrations of pollock are on Georges Bank, the Scotian Shelf, and in the Gulf of Maine. Young pollock are near shore, moving offshore around age 2. Pollock spend less time near bottom than other cod-like fish. Pollock show strong schooling behavior.

The western part of the management area (Areas 4X and 5) accounted for 91% of the catch in 2000. Only 9% came from Areas 4V and 4W. Catch in 2000 was 5507 tons, down from 8900 tons in 1999 and 14400 tons in 1998. Within Areas 4X and 5, most fish (55-65%) came from Areas 4X.

A variety of gear is used, primarily otter trawls and gillnets, but also handlines and longlines. The otter trawl and gillnet fisheries are often directed. Pollock are taken as by-catch in cod and haddock fisheries and in small-mesh silver hake and redfish fisheries. In 1999, by-catch in the silver hake fishery was only 6 tons and in the redfish fishery it was 436 tons; pretty small.

Large trawlers were once dominant, but accounted for only 16% of the catch in 2000. That fleet now directs most of its effort toward redfish and halibut. In 2000, smaller trawlers accounted for 42% and fixed gear (gillnet and longline) accounted for 41%.

The pollock stock is still depleted, but the current catch limit of about 6000 tons should permit rebuilding.

SILVER HAKE

A major concentration of silver hake is found on the Scotian Shelf, generally in deeper water on the shelf edge and in Emerald and LaHave Basins. In summer, spawners move into shallower water on Sable and Western Banks.

Fishing is restricted to Emerald and LaHave Basins and along the shelf edge west of 60°W in water > 190 m. In 2000, 12900 tons were caught. Through Oct 2001, 11700 tons were caught, 1900 of

which were from offshore, that is, the shelf edge. Fishing in Emerald and LaHave Basins is conducted year round by the <65' mobile gear fleet.

Silver hake are widely distributed (within their depth range). There is a high degree of uncertainty about the stock and catches should not be allowed to increase.

WHITE HAKE

White hake inhabit mud bottoms in depths from 50-200 m from the southern Grand Banks south. They are distributed throughout Areas 4VWX and 5 but are concentrated in the Laurentian Channel, the shelf edge, around Emerald and LaHave Basins and the Bay of Fundy. On average, 64% of the biomass is in Area 4X/5Z, 15% in 4W, 11% in 4Vs, and 9% in 4Vn.

According to the Groundfish Management Plan, there is supposed to be no directed white hake fishery. In 2000, 2432 tons were caught. Longliners take about 55%, gillnets 29%, and otter trawlers < 65' most of the rest. With otter trawlers over 90% of white hake caught are by-catch of predominately haddock and redfish fisheries. In the gillnet fishery, 57-79% of white hake caught are by-catch of predominately pollock and cod fisheries. Conversely, 50-90% of the longline catch of white hake is in a directed fishery, not by-catch. (This last seems contrary to the Management Plan.)

The abundance of white hake in Areas 4V and 4W is very low. The status in Area 4X has been poor but shows signs of recovery.

Because the Groundfish Management Plan states that there is no directed white hake fishery, and most of the catch is by-catch, white hake not be considered further.

REDFISH

Redfish are normally found on the slopes of banks and deep channels, in deep basins, and off the shelf; in 100-700 m.

Catches in Area 4V have been about 4000-5000 tons, with about half the catch coming in the first quarter of the year. Catches in Areas 4W and 4X have been about 5000-6000 tons.

Most (70-75%) of the fish caught in Areas 4W and 4X have been from the Crowell and Jordan Banks portions of the Gulf of Maine. There has been some fishing in Emerald and LaHave Basins (10-15%), in the Roseway Basin and Western Ridge (~5%) and on the slope (10-15%). Most fish in Areas 4W and 4X are caught from May through July (55-60%); 25% are caught August through October; few are caught from November through March (5-10%).

Since 1998, otter trawlers < 65' have caught almost all the fish. These trawlers are usually making 5 day trips. These boats are fishing a cumulative total of about 1500 days. Larger otter trawlers fished 20-50 days.

Several areas are closed to avoid by-catch of other species. Area 4W and Browns Bank are closed from Jan 1 to June 30. Browns bank, the Bay of Fundy north of 43°30'N, and all areas < 50 fathoms are closed year round.

The redfish population is stable.

FLATFISH

<u>Eastern Scotian Shelf (Areas 4V and 4W)</u>

American plaice are fished primarily on Banquereau Bank in Area 4Vs and in Sydney Bight in Area 4Vn. There has not been a yellowtail flounder fishery in Areas 4V or 4W since 1996. Between 1997 and 1999, the total catch of flounders and plaice in these areas was 1700-2000 tons. 1200-1300 tons (60-75%) were plaice. 30-90 tons (2-5%) were yellowtail flounder. 170-400 tons (10-25%) were witch flounder. 0-2 tons were winter flounder.

Plaice in Areas 4Vs and 4W are SE of Cape Breton I. The stock of plaice is low and there is presently little prospect for improvement. The stock of yellowtail flounder is very low and there are no prospects for improvement. (However, the Management Plan says that these plaice and yellowtail stocks have shown some improvement.)

Western Scotian Shelf (Area 4X)

There are few American plaice or yellowtail flounder in Area 4X. Thus, the bulk of the catch is winter flounder and witch flounder. In 1995 and 1996, the total catch of flounder and plaice in this area was 2000-2500 tons, of which 300-400 tons (13-20%) was witch flounder; the rest can assumed to be winter flounder. Total catches from 1997-2000 were between 1700-2200 tons; the same percentages probably hold. Winter flounder catches were common in offshore and nearshore areas of the Bay of Fundy and to the south and west of Nova Scotia, but rare to the east of Browns Bank.

Over 95% of the catch in this area was by otter trawlers < 100'. 45'-65' trawlers dominated, with over 50% of the catch. A subset of 22 vessels with a sustained history in the flounder fishery in Area 4X took part in a study – this is not the total fleet.

The outlook for the stocks in this area is that winter flounder are stable, yellowtail is improving, and American plaice is worsening.

Eastern Georges Bank (Area 5Z)

There is a major concentration of yellowtail flounder on Georges Bank to the east of the Great South Channel. The fish are found between 20 and 40 fathoms (37-73 m). Canadian catches have increased from 1200 tons in 1998 to 2000 tons in 1999 to 2859 tons in 2000.

Fishing is concentrated a relatively limited portion of Georges Bank called the Yellowtail Hole. Fishing is restricted to the latter half of the year. The fishery is conducted mainly from otter trawlers < 65'.

Population biomass is at historic highs.

Witch Flounder in Areas 4V, 4W and 4X

Witch flounder is worth more than the others and, therefore has been (sort of) separated from those others.

Witch flounder are usually in 50-300 m in deep holes and channels and along the shelf slope. The primary concentrations occur in Sydney Bight (4Vn) extending south (into 4Vs) along the slope of the Laurentian Channel. There are also concentrations in the holes north of Banquereau Bank, in the Gully, north of Emerald and LaHave Banks, and in the approaches to the Bay of Fundy. There is a notable scarcity from Emerald and LaHave Basins themselves and from the outer slopes of the banks from Sable to Browns. There is a low abundance in the central Scotian Shelf.

Boats <100' account for almost all landings. In 4X, otter trawlers dominate, while in 4Vn, Scottish and Danish seiners dominate. Since 1993, the total catch from all three sub-areas has been 600-900 tons. In 4X, catches come mainly from north and west of LaHave Basin and in the Gulf of Maine, up into the Bay of Fundy. There are some catches in deep water north of Browns Bank.

The outlook for witch flounder is positive.

OTHER GROUDFISH SPECIES

The above species accounted for about 90% of the landings in 2000. Other species, such as, halibut, cusk, wolffish, monkfish, skate, and dogfish contributed little. Thus, they are not considered.

GROUNDFISH BOAT DISTRIBUTIONS

The groundfish management plan gives the total numbers of mobile and fixed gear boats of various size classes fishing for groundfish. However, neither the management plan or the stock status reports give the number of boats fishing for any particular species. Therefore, the boats have been allocated to different species groups based on two factors: (a) any information in the stock status reports on types and sizes of boats fishing for a particular species, and (b) the annual catch of each species. It is assumed that it takes the same fishing effort to catch all species, or that the catch per unit effort (CPUE) is the same for all species. Thus , if x tons of species A is caught by y boats of a given size, then $2x$ tons of species B will be caught by $2y$ boats of the same size. The equal CPUE assumption does not hold for

widely differing species, but for groundfish caught in the same area by the same gear it is a reasonable assumption.

The following are the calculations that produce the number of large trawlers, small trawlers, and fixed gear boats that fish for each species or species group. The numbers used in the calculations are the catches for a species, the percentage of catch by a given size and type of boat, and the total number of any size and type of boat that fishes for that species. (SWNS is southwest Nova Scotia and BOF is Bay of Fundy.)

LARGE TRAWLERS

Catches

Pollock	16% of 5500 = 900 tons	(20%)
Silver Hake	15% of 12900 = 1900 tons	(42%)
Redfish		
4WX	12% of 5500 = 700 tons	(15%)
4V	≈ 1000 tons	(23%)
	4500 tons	(100%)

Trawlers

2 @ 65'-100'
11 @ > 100'
13 total

Pollock	20% x 13 = 2.6 → 1 @ 100' & 2 @ 65-100'
Silver Hake	42% x 13 = 5.5 → 5 @ 100'
Redfish	
4WX	15% x 13 = 2 → 2 @ 100'
4V	23% x 13 = 3 → 3 @ 100'

SMALL TRAWLERS

Catches

Pollock	42% of 5500 = 2300 tons	(6%)
Silver Hake	85% of 12900 = 11000 tons	(28%)
Redfish		
4WX	88% of 5500 = 4800 tons	(12%)
4V	≈ 3500 tons	(9%)
Flatfish	6300 tons	(16%)
Haddock		
SWNS & BOF	4700 tons	(12%)
Georges Bank	3600 tons	(9%)
Cod		
SWNS & BOF	2500 tons	(6%)
Georges Bank	500 tons	(2%)
	39200 tons	(100%)

Trawlers

131 < 65'

Pollock	6% of 131 = 7.9 →	7
Silver Hake	28% of 131 = 36.7 →	37
Redfish		
4WX	12% of 131 = 15.7 →	16
4V	9% of 131 = 11.8 →	12
Flatfish	16% of 131 = 21.0 →	21
Haddock		

	SWNS & BOF	12% of 131 = 15.7 →	16
	Georges Bank	9% of 131 = 11.8 →	12
Cod			
	SWNS & BOF	6% of 131 = 7.9 →	8
	Georges Bank	2% of 131 = 2.6 →	2

FIXED GEAR

Catches

Pollock			
	4W	9% of 41% of 5500 = 200 tons	(2%)
	4X & 5	91% of 41% of 5500 = 2100 tons	(19%)
Haddock			
	SWNS & BOF	2300 tons	(21%)
	Georges Bank	1800 tons	(16%)
Cod			
	SWNS & BOF	3500 tons	(32%)
	Georges Bank	1100 tons	(10%)
		11000 tons	

Catches in 4X & 5

Pollock		2100 tons	(19%)
Haddock			
	SWNS & BOF	2300 tons	(21%)
	Georges Bank	1800 tons	(17%)
Cod			
	SWNS & BOF	3500 tons	(33%)
	Georges Bank	1100 tons	(10%)
		10800 tons	

Boats

4W	129 @ < 45'
4X & 5	754 @ < 45'
All	20 @ 45'-65'
All	11 @ 65'-100'

4W 129 @ < 45' for Pollock

2% of 20 or 11 is < 0.5, so no boats > 45' will be assigned.

4X & 5 < 45'

Pollock		19% of 754 = 143
Haddock		
	SWNS & BOF	21% of 754 = 158
	Georges Bank	17% of 754 = 128
Cod		
	SWNS & BOF	33% of 754 = 249
	Georges Bank	10% of 754 = 76

4X & 5 45'-65'

Pollock		19% of 20 = 4
Haddock		
	SWNS & BOF	21% of 20 = 4
	Georges Bank	17% of 20 = 3
Cod		

SWNS & BOF 33% of 20 = 7
Georges Bank 10% of 20 = 2

4X & 5 65'-100'

Pollock 19% of 11 = 2

Haddock

SWNS & BOF 21% of 11 = 2
Georges Bank 17% of 11 = 2

Cod

SWNS & BOF 33% of 11 = 4
Georges Bank 10% of 11 = 1

The above calculations for pollock, haddock, and cod assume that all boats sizes are equally distributed in SWNS/BOF and Georges Bank. It seems unlikely that any boats < 35' will venture to Georges Bank. FAO statistics for Canada show few trawlers < 45' (≈ 25 tons), so the above distribution for trawlers is okay. FAO statistics for Canadian gillnetters < 45' indicate that 20% are 40'-45', 20% are 35'-40', and 60% are < 35'. FAO statistics for Canadian longliners < 45' indicate that 8% are 40'-45', 13% are 35'-40', and 80% are < 35'. We will assume that all boats > 40' go to Georges Bank and all boats < 40' do not. Therefore, we assume that about 15% of 754, or 113 boats 40'-45' go to Georges Bank and 641 fish SWNS/BOF. Then for boats < 45':

Georges Bank

Pollock 15% of 143 = 21
Haddock 15% of 286 = 43
Cod 15% of 325 = 49

SWNS & BOF

Pollock 85% of 143 = 122
Haddock 85% of 286 = 243
Cod 85% of 325 = 276.

All the boats > 45' go to Georges Bank.

45'-65'

Pollock 4
Haddock 7
Cod 9

65'-100'

Pollock 2
Haddock 4
Cod 5.

REFERENCES

All references but the first are DFO reports downloaded from the DFO web site. The management plan does not have report numbers or publication dates.

1. Bulletin of Fishery Statistics: Fishery Fleet Statistics 1970, 1975, 1980, 1985, 1989-1995, Food and Agriculture Organization (FAO) of the United Nations, Rome, 1998.
2. Groundfish Integrated Fisheries Management Plan, Scotia-Fundy Fisheries, Maritimes Region, April 1, 2000 – March 31, 2002.
3. Updates on Selected Scotian Shelf Groundfish Stocks in 2001, DFO Stock Status Report A3-35, 2002.
4. Eastern Scotian Shelf Cod, DFO Stock Status Report A3-03, 1998.
5. Cod on the Southern Scotian Shelf and in the Bay of Fundy (Div. 4X/5Y), DFO Stock Status Report A3-05, 2000.

6. Eastern Georges Bank Cod, DFO Stock Status Report A3-04, 2001.
7. Eastern Scotian Shelf Haddock (Div. 4TVW), DFO Stock Status Report A3-06, 2001.
8. Haddock on the Southern Scotian Shelf and Bay of Fundy (Div. 4X/5Y), DFO Stock Status Report A3-07, 1999.
9. Eastern Georges Bank Haddock, DFO Stock Status Report A3-08, 2001.
10. Assessment of the status of Div. 4TVW Haddock: 2000, DFO Research Document 2001/100, 2001.
11. Pollock in Div. 4VWX and SA 5, DFO Stock Status Report A3-13, 1999.
12. Silver Hake on the Scotian Shelf, DFO Stock Status Report A3-09, 1999.
13. White Hake in 4VWX and 5, DFO Stock Status Report A3-10, 2001.
14. Assessment of the status of 4VWX/5 White Hake, 2001, DFO Research Document 2001/104, 2001.
15. Update on the Status of Redfish Stocks in the Northwest Atlantic: Redfish in Units 1 and 2, and in Division 3O, DFO Stock Status Report A1-01, 2001.
16. Update on the Status of Unit 3 Redfish, 1999, DFO Research Document 99/152, 1999.
17. American Plaice and yellowtail Flounder on the Eastern Scotian Shelf (Div. 4VW), DFO Stock Status Report A3-34, 2000.
18. Southwest Nova Winter Flounder, American Plaice, and Yellowtail Flounder, DFO Stock Status Report A3-21, 1997.
19. Yellowtail Flounder on Georges Bank, DFO Stock Status Report A3-15, 2001.
20. Witch Flounder in Div. 4VWX, DFO Stock Status Report A3-19, 1997.
21. Atlantic Halibut on the Scotian Shelf and Southern Grand Banks (Div. 4VWX 3NOPs), DFO Stock Status Report A3-23, 2001.
22. Cusk on the Scotian Shelf, DFO Stock Status Report A3-14, 1998.
23. Wolfish on the Scotian Shelf and Georges Bank and in the Gulf of St. Lawrence (Subarea 4 and Div. 5YZe), DFO Stock Status Report A3-31, 2000.
24. Monkfish on the Scotian Shelf and Northeast Georges Bank (4VWX and 5Ze), DFO Stock Status Report A3-30, 2000.
25. Winter Skate on the Eastern Scotian Shelf (4VsW), DFO Stock Status Report A3-29, 2000.

APPENDIX B - DFO SPECIES NOTES ON PELAGIC FISHES

HERRING

Herring are managed as five separate stocks: (a) SW Nova Scotia/Bay of Fundy, (b) Offshore Scotian Shelf Banks, (c) Coastal Nova Scotia (South Shore, Eastern Shore, Cape Breton), (d) SW New Brunswick, and (e) Georges Bank. The fishery is dominated by purse seine, weir, and gillnet, with minor landings by shutoff and trap. There are 28 active purse seine, 1 midwater trawl, 2050 gillnet, and 270 trap and weir licenses throughout the region. Gillnet boats are < 45'. In eastern Nova Scotia (north of 44°52'N), fishing occurs primarily during winter months. In central and western Nova Scotia (south of 44°52'N), the fishery is in summer and fall. In the upper Bay of Fundy, the fishery is limited to July and September.

The SW Nova Scotia/Bay of Fundy stock has been estimated to have decreased from 570,000 to 460,000 tons from 1997 to 2000, with 65 % to 91% occurring on German Bank and 8% to 28% occurring in Scots Bay. Total catch in SW Nova Scotia/Bay of Fundy in 2000 was 85250 tons. Purse seiners caught 83760 tons (98%); gillnets caught 820 tons (1%); and Nova Scotia weirs caught 700 tons (1%). 2000 catches in gillnets and weirs were much lower than in previous years. In 1997, gillnets accounted for 3% of the catch and weirs accounted for 6%. The largest purse seine fisheries were on German Bank and Scots Bay spawning grounds; summer feeding fish around Gannet/Dry Ledge, off Long Island, NS, and around Grand Manan I. In 2000, 70% of the purse seine catch occurred in July through September; 8% in June and 15% in October. There was a limited purse seine fishery during the winter in Chedabucto Bay and off Halifax Harbour (Chebucto Head). The gillnet fishery took place in June in the Spectacle Buoy area and in August/September on Trinity Ledge. The gillnet season runs from June 1 through November 30 from 1900 to 0700 on Sunday-Thursday.

A purse seine herring fishery on the outer Scotian Shelf banks began in 1996 when 12000 tons were caught. In 1997, the catch increased to 20000 tons, but it dropped to 5600 tons in 1998 and 2000 tons in 2000. In 1998 fishing took place in May and June around Emerald Basin, The Patch, and Mackenzie Spot. In 2000, 85% of the catch was in June, with small amounts in May and July. Reductions in catches are attributed to changes in herring behavior and distribution, not collapse of the stock. The fish were widespread over the banks in July 2000 and a 2001 quota was set at 12000 tons. Seiners fish at least 25 nm offshore of the eastern coast of Nova Scotia except for Chedabucto Bay.

There has been an increased effort in the central Nova Scotia inshore gillnet fishery in recent years. Boats generally fish 20-30 days in spring and/or fall. There are four fishing areas. Catches East of Halifax in September and October were 1100 tons in 1998 and 1350 tons in 2000. Catches in the Little Hope area, southwest of Liverpool in September and October were 1170 tons in 1998 and 2040 tons in 2000. There has been little coastal herring fishing in Shelburne County in recent years apart from the Little Hope area. Other coastal fisheries were in Glace Bay (1730 and 830 tons in September-October 1998 and 2000, respectively) and Bras d'Or (122 and 60 tons in April-May 1998 and 2000, respectively) in Cape Breton.

In SW New Brunswick there is a weir and shutoff fishery for juvenile herring near shore at the mouth of the Bay of Fundy. The 1998 catch was 20000 tons (18000 tons from 104 weirs in New Brunswick and 4000 tons from 14 weirs in Nova Scotia) and the 2000 catch was 17000 tons (16400 tons from 77 weirs in New Brunswick and 700 tons from 2 weirs in Nova Scotia). Fishing is primarily from July through November, with the biggest catches in July, August and September.

No Canadian landings were reported from Georges Bank in 1998. For 1999, there was an allocation of 20000 tons.

MACKEREL

Mackerel are highly migratory. The northward springtime migration begins along the New England coast and continues through May and June on Georges Bank and the Scotian Shelf. The spring

migration is mostly offshore and the fish do not move toward shore until water temperature and food conditions are favorable.. Mackerel arrive in the Gulf of St Lawrence in late May through early July. Most spawning takes place in the southern Gulf, although there is some spawning on the Scotian Shelf. After spawning, mackerel disperse in the Gulf. The southward migration from the Gulf takes place from September through November.

The mackerel fishery is essentially a close inshore fishery conducted by "a very large number of fishermen". The main types of gear are gillnets, lines, purse seines, and traps; the gear varying with region and season. Traps and gillnets are used in Nova Scotia during the spring migration from May through June. Trapnets also catch substantial numbers of juveniles in July. The most important trapnet fishery in Nova Scotia is in St Margaret's Bay, near Halifax. Gillnets and driftnets are used in the Gulf in June and July. In July and August in the Gulf there is a purse seine fishery and from August through October there is a line fishery. In fall, there is a large and small purse seine fishery on the west coast of Newfoundland. (These seasonal gear descriptions are from 1997.)

In 1996 in Scotia-Fundy, the following mackerel licenses were issued: 725 handlines < 45', 1843 gillnets, 202 trapnets, and 44 purse seines < 45'. Trapnet licenses were non-vessel based, the others were vessel based.

In 2001, 15300 tons of mackerel were caught. 7600 tons were caught by purse seiners off the west coast of Newfoundland. Jiggers, gillnets and traps caught 2800, 2500 and 2200 tons. 2700 tons were caught in Nova Scotia and 400 tons were caught in New Brunswick.

On average between 1995 and 1999, jiggers, gillnets and traps caught 4800, 6100 and 4100 tons compared to 2100 tons for purse seines. 2000 and 2001 seem to be unusual years because a very large 1999 year class caused many small, unwanted, mackerel to be caught.

Between 1995 and 1999 catches on the Scotian Shelf came from Areas 4W and 4X. 11% was from 4Wd (around Canso), 3% from 4Wk (around and east of Halifax), 81% was from 4Xm (west of Halifax), 3% from 4Xo (off Shelburne), and 2% from 4Xs (New Brunswick side of Bay of Fundy). The gear used in Areas 4W and 4X between 1995 and 1999 included traps (74% of catch), gillnets (11%), handlines (9%), jiggers (4%), otter trawls and purse seines (1% combined), and others. In 2000, 81% of the catch in Areas 4W and 4X was caught in June, 11% was caught in May, and the remaining 8% was caught from July through October (≈2%/month).

CAPELIN

Capelin have generally been absent from the Scotian Shelf. Their presence, which is confined to the eastern half of the Shelf (Area 4Vs), is due to colder than normal water. There has never been a directed fishery for capelin on the Shelf. Thus, they need not be considered.

TUNAS

From 1996 to 2000, 600 to 700 tons of tuna were caught in the Scotia-Fundy area. Longlines are the only gear. Albacore, bigeye and yellowfin tuna are found on Georges Bank, the Scotian Shelf, and the Grand Banks during the summer. Albacore and bigeye are fished in deep waters along the edge of the Scotian Shelf. Yellowfin are caught in shallower waters; they are fished on Georges Bank and the banks along the edge of the Scotian Shelf. Between 1991 and 1997, most of the catches have been bigeye and yellowfin, with a few albacore. (Assume half bigeye and half yellowfin.) It appears that in 1997 there was only 1 offshore tuna license. However, in 1997, there were 77 swordfish longliners eligible to fish for tuna. Longliners fishing for shark are not allowed to keep tuna. Tuna can be fished year round. The Bay of Fundy and Area 4Wd are closed to tuna fishing.

SWORDFISH

Swordfish are found on edges where water goes from shallow to deep and where there are distinct thermoclines. From 1996 to 2000, 600 to 1000 tons of swordfish were caught in the Scotia-Fundy area. Longlines are virtually the only gear, a small percentage of fish is caught with harpoon. Swordfish are

caught primarily along the edge of Georges Bank, the Scotian Shelf, and the Grand Banks. The fishery usually starts in early June and extends through October. The season starts on June 1 east of 65.5°W and on August 1 west of 65.5°W. The season closes on September 1 for the area surrounding Emerald and LeHave Basins. In 1997 there were 77 swordfish licenses issued, 67 for Scotia-Fundy and 10 for Newfoundland. 69 boats were <65' and 8 were 65'-100'. Principal landing ports in Nova Scotia are Shelburne, Sambro and Clark's Harbour.

SHARKS

From 1992 to 1996 between 1000 and 2000 tons of sharks were caught in Atlantic Canada, about 80% were porbeagles, the rest were mostly blue and mako. These totals exclude dogfish. In 1996 there were 23 licenses in Scotia-Fundy and 32 in the Gulf/Newfoundland/Quebec. In 1994, total landings of porbeagle were 1550 tons, 1470 tons by 3 offshore freezer vessels and 80 by numerous inshore vessels. In 1995 the catch was 1380 tons.

Porbeagles inhabit inshore and offshore waters. They move on the Scotian Shelf in late spring and back to deeper water in late fall. They are caught off the shelf and in deep water basins such as Emerald Basin in winter. The primary porbeagle fisheries are in Areas 4W and 4X in the spring and in the Gulf and on the Grand Banks in the fall.

Blue sharks move on the Scotian Shelf in late spring and back to deeper water in late fall. The fishery for blue sharks peaks in fall and early winter, primarily off the Scotian Shelf and Grand Banks.

The season is year round, although the area west of 65.5°W may be closed from May 1 through August 1. Gear is longline or handline. No by-catch of tuna or swordfish is allowed.

REFERENCES

All references are DFO reports downloaded from the DFO web site. The management plans do not have report numbers or publication dates.

1. 4VWX and 5Z Herring, DFO Stock Status Report B3-05, 1999.
2. 4VWX Herring, DFO Stock Status Report B3-03, 2001.
3. 2001 Evaluation of 4VWX Herring, DFO Research Document 2001/057, 2001.
4. Questionnaire Survey of the Coastal Nova Scotia Herring Fishery, DFO Canadian Stock Assessment Secretariat Research Document 99/137, 1999.
5. 1999-2001 Scotia-Fundy Fisheries Integrated Herring Management Plan NAFO Sub-Divisions 4WX, 4VN and 5Z.
6. Status of the stock of Atlantic mackerel (*Scomber scombrus* L.) in NAFO Subareas 3 and 4 in 2000, DFO Research Document 2001/081, 2001.
7. The Atlantic mackerel (*Scomber scombrus* L.) of NAFO Subareas 3-4, DFO Canadian Stock Assessment Secretariat Research Document 2000/021, 2000.
8. Atlantic Mackerel of the Northwest Atlantic – Update (2001), DFO Stock Status Report B4-04, 2002.
9. Integrated Fisheries Management Plan Atlantic Mackerel 1997-1999.
10. Scotian Shelf Capelin, DFO Stock Status Report B3-06, 1997.
11. Canadian Atlantic Integrated Fisheries Management Plan Bigeye, Yellowfin, Albacore Tunas 1998-1999.
12. The Canadian Atlantic Swordfish (*Xiphias gladius*) Fishery 1997-1999 Integrated Management Plan.
13. Canadian Atlantic Pelagic Shark Integrated Fishery Management Plan 1997-1999.

APPENDIX C - DFO SPECIES NOTES ON SHELLFISH

LOBSTER

Eastern and Southern Shore of Nova Scotia

Lobster fishing areas cover the southern shore of mainland Nova Scotia, extending about 50 nm offshore. The fishery is a "nearshore" trap fishery. In 1998, there were 140 licenses from Chedabucto Bay to about Sheet Harbour, 160 from Sheet Harbour to about Dartmouth; and 760 from Dartmouth to Barrington; all licenses are being used. Average boat lengths in 1999 were 31'-32' east of Dartmouth and 36' west of Dartmouth. Fishing used to be (1983) conducted in waters < 15 fm (30 m) deep, but it has now extended into deeper water (< 30 fm (50 m)).

The lobster season is April through June east of Dartmouth and from the last Monday of November through May west of Dartmouth. The average number of days fished was 44 east of Sheet Harbour, 51 between Sheet Harbour and Dartmouth, and 50 west of Dartmouth. East of Dartmouth, catches were reasonably constant through the season. West of Dartmouth, half the catch occurred in the first 11 fishing days. Between 1995 and 1997 catches east of Sheet Harbour were 146-193 tons; between Sheet Harbour and Dartmouth they were 216-239 tons; and west of Dartmouth they were 1443-1792 tons.

Southwest Nova Scotia

In 2000 there were 980 licenses from Barrington around to Digby. The fishing area extends 50 nm offshore.. The only fishing gear is trap. The season is from the last Tuesday of November through May. Catches from 1995 through 2000 have been 10000- 13000 tons. 48% of the catch has come in the first four weeks of the season (November/December); 12% in January; 4% in February; 5% in March; 11% in April; and 21% in May.

90% of the catch comes from the traditional nearshore fishery (< 30 fm). There is a midshore fishery with 100-200 of the inshore vessels fishing out to 50 nm from part to all of the season. BrowNova Scotia Bank, is closed to lobstering.

Bay of Fundy

In the upper Bay of Fundy, the season runs from October 15 through December 31 and from April 1 through July 31. There were 96 licenses in 2001. Catches from 1995 through 2000 have been between 560 and 950 tons.

Off New Brunswick, the season runs from mid November through January 14 and from March 31 through June 30. There were 170 licenses in 2001. Catches from 1995 through 2000 have been 410 to 810 tons.

Around Grand Manan I., the season runs from mid November through June 30. There were 109 licenses in 2001. Catches from 1995 through 2000 have been between 550 and 810 tons.

Eastern Cape Breton

In this region, the season is mid-May to mid-July. There are 656 licenses. Landings have decreased from 2700 tons in 1993 to 1500 tons in 1997.

Offshore

This fishery takes place more than 50 nm from shore. All fishing occurs off west Browns Bank (Crowell Basin, Georges Basin, SW Browns), southeast Browns Bank (outer shelf and upper slope east of Northeast Channel) in Area 4X and Georges Bank (outer shelf and upper slope) in Area 5Z. There is a closed area that encompasses all portions of Browns Bank < 50 fm. The offshore quota is 720 tons. Between 1995 and 1999, catches have been between 540 and 727 tons. In those years 50-60% of the catch has been from west Browns, and 20-25% each from SE Browns and Georges. The offshore area extends to the Laurentian Channel but there has not been any fishing east of 63°W.

The season is year round and the only gear is traps. Highest catches are in November and December.

There 8 boats/licenses in the offshore fleet. They are based in Shelburne and Lockeport in SW Nova Scotia. They generally spend 4-5 days at sea per trip. The boats range from 56' to 140' long. Two are <65'. One is 99'. Five are between 100' and 140'. The larger boats are capable of fishing year round. There are 65 fishermen on these 8 boats.

These boats can also catch Jonah crab. Some boats target crab and some target both, particularly during summer.

SCALLOPS

Scallops live in beds on sand or gravel bottoms at depths of 35 to 120 m. Scallop fishing is separated into inshore and offshore fleets. In 1998 and 1999, the offshore fleet caught around 5200 tons. In 2001, the inshore fleet caught about 1200 tons and in the mid 1990s it caught about 2400 tons.

However, the overall DFO catch statistics for all species in eastern Canada say that in 1996, 1998, and 2001, 40000, 49000, and 84000 tons of scallops were landed in the Scotia-Fundy portion of Nova Scotia and 1800, 1600, and 1600 tons were landed in the Scotia-Fundy portion of New Brunswick. These figures can't be reconciled. There is no significant aquaculture for scallops. The status reports give landings for "meats". Maybe the overall statistics include the shells, but that doesn't seem right; in DFO quotas for all species, the scallop quota is for meats. Maybe boats from Nova Scotia and New Brunswick are fishing for scallops somewhere else and landing them in home ports. However, the total 2001 quota for Areas 3, 4 and 5 was 19355 tons, so the rest would have to come from north of Newfoundland. However, the northern limit of sea scallops is northern Newfoundland and the northern Gulf of Labrador. The only logical guess is that the discrepancy is with meats versus shells.

Offshore

Offshore scallop vessels range from 27 to 45 m (88'-147'). Gear is scallop rakes or drags. The offshore fleet fishes south of 43°40'N (near Yarmouth). There are 76 licenses but only 28 boats were fishing in 1999 (down from 68 in 1984). In 1999, there were about 500 offshore scallop fishermen. There were 509 offshore scallop landings (trips?) in 1999.

The fishery is conducted on the eastern Scotian Shelf (Middle Grounds, Sable Island Bank, Western Bank, Banquereau Bank), Browns and German Banks, and Georges Bank. The season is year round except on German Bank, where it runs from June 1 through November 15, so that it doesn't conflict with the lobster season.

Catches for 1998 and 1999 were 4000 and 3700 tons on Georges Bank, 600 and 500 tons on Browns Bank, 300 and 600 tons on German Bank, 50 and 150 tons on Banquereau Bank, and 265 and 277 tons on Sable Island and Western Banks. Total offshore catches were 5207 for 1998 and 5124 for 1999. There has been no fishing on the Middle Grounds since 1997. In 1996 levels of effort were 30000 hours on Georges Bank, 6000 on Browns Bank, 2400 on German Bank, and 4700 on the eastern Shelf.

Bay of Fundy

There are three "inshore" scallop fishing fleets in the Bay of Fundy. The Full Bay Fleet consists of 99 boats, 45'-65', that can fish anywhere. The Mid Bay Fleet consists of 210 boats, 30'-45', that fish on the New Brunswick side of the Mid Bay Line. The Upper Bay Fleet consists of 16 boats that fish east of about 65°W. The total inshore catch in 2001 was about 1200 tons.

The season in most of the Bay is year round. However, in 2001 the Full Bay Fleet caught 285 tons versus its 240 ton quota by September 30 and the Middle and Upper bay Fleets caught 59 and 43 tons versus their combined 80 ton quota by April 27. So fishing was stopped well before the end of the year.

The season in the Bay around Digby is from October 1 through April 30. In 2001 the Full Bay Fleet caught 102 tons against a quota of 110 tons. Fromm 1995-2000 fishing effort has been between 5000-10000 hours.

In Annapolis Basin the season is 9 days in January. In 1997 5 tons were caught.

Around Grand Manan I. the season is January 14 through May 31. In 2001, the Full Bay Fleet caught 16 tons versus its quota of 50 tons and the Mid Bay Fleet caught 145 tons versus its 105 ton quota. Thus, the total catch was 161 tons versus a total quota of 155 tons.

Outside the Bay of Fundy

Outside the Bay, south of 44.3°N and west of 66.8°W, the season is year round, but in 1995 only 3 tons were caught, indicating that there is virtually no fishery.

Outside the Bay, south of 44.3°N, north of 43°40'N, and east of 66.8°W, the season is from June 1 through October 30. The Full Bay Fleet quota for 2001 was 200 tons but only 163 tons were caught, primarily because the Full Bay Fleet went south of 43°40'N, where the fishing was better. In 1994 and 1995, the boats fished about 80,000 hours, but catches were about twice as high as in 2001.

The Full Bay Fleet is generally limited to fish north of 43°40'N; the offshore fleet fishes south of this latitude. However, since 2001 the Full Bay Fleet is allowed to fish inside 12 nm west to 65°30'W from June 11 through August 31. In 2001 the quota of 400 tons was caught.

SHRIMP

In 1998 there were 23 Scotia-Fundy based trawlers, < 65', and 6 Gulf based trawlers, 65'-100' fishing on the Scotian Shelf. These boats employed 116 fishermen. Fishing is concentrated in three deepwater "holes": Louisbourg, Misaine, and Canso.. Starting in 1998, trawling began inshore near Canso around Bad Neighbor and 44% and 28% of the total catch in 1999 and 2000 came from that area. Catches in 1999 and 2000 were 717 and 440 tons around Louisbourg Hole, 1521 and 2088 tons around Misaine Hole, and 2464 and 2772 tons around Canso Hole. Total trawl catches were 4702 and 5300 tons for 1999 and 2000.

The fishery is year round but weather conditions keep the Gulf boats from starting until mid March and the Scotia-Fundy based boats from starting until mid April. The Gulf fleet takes its quota (25% of the TAC) by the end of June. The Scotia-Fundy fleet catches about 75% (75% of the TAC) of its catch by the end of July; the quota is almost reached by the end of October but some fishing may take place into December. 50-60% of the catch is in May-June; about 20% in March-April; and about 20% July-December.

The Scotia-Fundy fleet is considered an "inshore" fleet and the Gulf fleet is considered a "midshore" fleet. In 1997, both fleets fished a total of 941 days, with an average trip length of 3.5 days, meaning the combined fleets made about 270 trips.

Most of the catch is landed in eastern Nova Scotia (Larrys River, Canso) and eastern Cape Breton (Arichat, Louisbourg).

A small inshore trap fishery began between Canso and Louisbourg in 1994. In 1997 there were 14 licenses. The catches in 1999 and 2000 were 149 and 117 tons.

Cod, hake, redfish, and flounder are major predators of shrimp. Decreases in these species during the 1990s may be a major reason for the increase in shrimp.

Total catches for both trawl and trap fisheries for 1999 and 2000 were 4851 and 5417 tons. However, the DFO statistics for all species in eastern Canada say that in 2000, 23000 tons of shrimp were landed in the Scotia-Fundy portion of Nova Scotia. The 2001 quota for the three "holes" is 4660 tons.

The 2001 quota north of 49°15'N was 23687 tons. In 1997 there were 13 offshore factory freezer trawlers fishing 17 licenses. Boats have 17-28 man crews. The season is year round. The boats make 25-75 day trips. Larger boats make 6-8 trips/year and are out 270-320 days. Smaller boats make 8-10 trips/year and are out 200-250 days. Landings are in Newfoundland and Nova Scotia.

CRABS

Snow Crabs

Snow (queen) crabs are fished at about 90-180 m in SW Nova Scotia and 50-280 m in eastern Nova Scotia. SW Nova Scotia is the southern limit for these crabs, none have been fished on Georges Bank.

In Area 4X, fishing is in only the Roseway Basin Area and an area north of LaHave Basin. The season is from November 1 through June 1. In 2000-2001, 4 boats fished 4 licenses and caught 213 tons. Comparison of 1997 and 2001 trap hauls indicates that boats fished about 60 days in 2001.

In 2000 and 2001, 1000-1100 tons were caught by 80 licenses (boats) NE of Cape Breton I. In 2000 and 2001, 4400 and 4800 tons were caught by 85 licenses SE of Cape Breton I. In 2000 and 2001, 4300 and 4000 tons were caught by 82 licenses off the eastern part of the Nova Scotia mainland. It is stated that the season starts on June 1, but no ending date is given.

Jonah Crabs

Jonah crabs extend from Nova Scotia to South Carolina. They are found primarily at 50-300 m off Nova Scotia. Jonah crabs are caught as by-catch in the lobster fishery.

There is an offshore fishery with 8 offshore lobster boats fishing in Areas 4X and 5 and 1 fishing in Area 4W. From 1996 through 1999 catches have been about 700 tons from Georges Bank, Georges Basin, Browns Bank, and Crowell Basin. The season is year round, beginning in October.

There is a fishery from 12-50 nm from shore along the northern and western portions of LaHave Basin. The season runs from June 15 to November 15, opposite the lobster season, although Jonah crab and lobster fishing grounds do not overlap in this area. Catches in 1998 and 1999 were about 160 tons. In 1998-1999 there were 9-10 boats fishing 15-20 days. There were about 60 3-4 day trips each year.

Jonah crabs have been found in commercial concentrations in only two areas in the SW Nova Scotia/Bay of Fundy area. Catches by 5 and 4 boats off southern Grand Manan I. were 61 and 51 tons in 1998 and 1999. Catches by 6 and 5 boats in the midshore off SW Nova Scotia were 54 and 119 tons in 1998 and 1999.

Rock Crabs

Rock crabs concentrate in waters < 20 m. There is a directed fishery for these crabs and a significant number are caught as by-catch in the lobster fishery. Along the Nova Scotia coast, the season is outside lobster season, from July through December, with the effort evenly distributed. In the Bay of Fundy the season is year round, but the catch is essentially 70% summer and 30% fall.

In SW New Brunswick, 6 and 5 boats caught 37 and 24 tons in 1998 and 1999. In St Marys Bay and Annapolis Basin, 4 boats caught 29 and 30 tons in 1998 and 1999. No rock crabs were caught around Grand Manan I. between 1996 and 1999. Off the eastern part of the Nova Scotia mainland, 9 and 10 each boats fished 35 to 40 days and caught 57 and 48 tons in 1998 and 1999. Off Cape Breton I., 17 boats fished each 76 days and caught 220 and 203 tons in 1998 and 1999.

Red Crabs

Red crabs are fished in a narrow 380-760 m depth zone extending from the US-Canada boundary on Georges Bank through Area 4W. Catches in 1995 and 1996 were around 700 tons by 5 licenses; 30-40% from Emerald Bank, 20-30% from LaHave Bank, 15-20% from Browns Bank, and 10-30% from Georges Bank. About 5% of the effort was in winter, 30% in spring and fall and 35% in summer. This fishery did not appear to be viable in 1998 and may have ended.

CLAMS

Arctic (Stimpson) surf clams are caught in an offshore fishery on Banquereau and Grand Banks and in an inshore fishery off SW Nova Scotia and in the Gulf.

The offshore fishery is conducted year round by three freezer vessels around 200' using hydraulic dredges. One ship has a crew of 33 for 42 day trips, with 30 backup crew. The TACs for Banquereau and Grand Banks are 30000 and 20000 tons (shell weight). Catches vary between the banks. In 1995 and 1996 total catches were about 25000 tons; in 1995 10000 tons were caught on Banquereau and in 1996 19000 tons were caught. A by-catch of 10% ocean quahaug is permitted.

Offshore vessels are not permitted within 20 nm of land, in the Gulf or Bay of Fundy, or west of 65.5°W.

In 1998 there were 33 boats fishing inshore in SW Nova Scotia with about 3 men/boat. The trips are day trips. The catch was about 25000 tons. (This information is from www.lobsterconservation.com. The catch seems high. Total in and offshore catches for all of Atlantic Canada in 1998 were 31000 tons.)

An inshore fishery for ocean quahaug is conducted in SW Nova Scotia. There are three licenses, which also fish for surf clams. In 1996 142 tons were landed in Liverpool and Lockeport. Catch rates could be as much as 3 tons/day but are usually less. Fishing is within 12 nm of shore.

SEA URCHINS

Sea urchins are generally caught by divers near shore in waters of 10 m or less. In 2000, there were 31 active licenses in Nova Scotia and 31 in New Brunswick. Boats are large enough to carry two diving skiffs, each with two divers.

From 1995 to 2000, catches in New Brunswick have been 1400-1900 tons from around Grand Manan I. and the adjacent mainland, the western end of New Brunswick. The season is October/November through mid April or May.

From 1995 to 2000, catches in Nova Scotia have been 900-1300 tons from the coast from Cape Breton to Digby. Catches are evenly distributed from September through March.

REFERENCES

All references are DFO reports downloaded from the DFO web site. The management plans do not have report numbers or publication dates.

1. Eastern Cape Breton Lobster (LFAs 27-30), DFO Stock Status Report C3-59, 1998.
2. Eastern and South Shore Nova Scotia Lobster LFAs 31-33, DFO Stock Status Report C3-60, 1998.
3. Southwest Nova Scotia Lobster, (Lobster Fishing Area 34), DFO Stock Status Report C3-62, 2001.
4. Bay of Fundy Lobster (LFAs 35, 36, and 38), DFO Stock Status Report C3-61, 2001.
5. LFA 41 Offshore Lobsters, DFO Stock Status Report C3-14, 2000.
6. Lobster Fishing Effort on the Outer Coast of Nova Scotia, 1983 Versus 1998, DFO Research Document 2002/022, 2002.
7. Offshore Lobster (LFA 41) Integrated Fishery Management Plan, Maritimes Region 1999-2000.
8. Eastern Scotian Shelf Scallop, DFO Stock Status Report C3-19, 1997.
9. Browns Bank Scallop, DFO Stock Status Report C3-18, 1998.
10. German Bank Scallop, DFO Stock Status Report C3-20, 1997.
11. Georges Bank Scallop, DFO Stock Status Report C3-17, 2001.
12. Scallop Production Areas (SPAs) in the Bay of Fundy, DFO Stock Status Report C3-56, 2002.
13. Area 1 Middle Bay of Fundy Scallop, DFO Stock Status Report C3-23, 1997.
14. Areas 2, 5, 7 Bay of Fundy Scallop, DFO Stock Status Report C3-24, 1997.
15. Area 3 Brier Island/Lurcher Shoal Scallop, DFO Stock Status Report C3-21, 1997.
16. Scallops in Production Area 4 (SPA) in the Bay of Fundy, DFO Stock Status Report C3-22, 2000.
17. Area 6 Southwest New Brunswick Scallop, DFO Stock Status Report C3-25, 1997.
18. 2000 Scotia-Fundy Offshore Scallop Integrated Fisheries Management Plan, Maritimes Region.
19. Northern Shrimp (*Pandalus borealis*) on the eastern Scotian Shelf – review of the 2000 fishery and outlook for 2001, Research Document 2001/003, 2001.
20. 1998-2002 Scotian Shelf Shrimp (*Pandalus borealis*) Integrated Mobile Gear Fisheries Management Plan, Scotia-Fundy Fisheries, Maritimes Region.
21. Eastern Nova Scotia Snow Crab, DFO Stock Status Report C3-02, 2002.
22. Southwestern Nova Scotia Snow Crab, DFO Stock Status Report C3-65, 2002.
23. Scotian Shelf (LFA 33) Jonah Crab (*Cancer borealis*), DFO Stock Status Report C3-09, 2000.
24. Inshore Gulf of Maine Jonah Crab (*Cancer borealis*), DFO Stock Status Report C3-66, 2000.
25. Offshore (LFA 41) Jonah Crab (*Cancer borealis*), DFO Stock Status Report C3-68, 2000.
26. Rock Crab – Eastern Nova Scotia, DFO Stock Status Report C3-05, 2000.

27. Inshore Gulf of Maine Rock Crab (*Cancer irroratus*), DFO Stock Status Report C3-67, 2000.
28. Scotian Shelf Red Crab, DFO Stock Status Report C3-11, 1998.
29. Banquereau Bank Arctic Surfclam, DFO Stock Status Report C3-34, 1999.
30. Scotian Shelf Ocean Quahaug, DFO Stock Status Report C3-37, 1998.
31. Offshore Surf Clam Integrated Fishery Management Plan, Maritimes and Newfoundland Regions 1998-2002.
32. Nova Scotia Green Sea Urchins, DFO Stock Status Report C3-48, 2000.
33. Southwestern New Brunswick (LFA 36-38) Green Sea Urchins, DFO Stock Status Report C3-49, 2000.